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MONOGRAPH OF THE GENUS MONARDELLA[1, 2]

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INTRODUCTION

The following paper records the results of a study of the species of *Monardella*, a Labiate genus of western North America. The object of this investigation was to ascertain the relationships and geographical distribution of the various elements which constitute this natural group of plants. The work was done mainly at the Missouri Botanical Garden during the years 1922–24, but during its course the collections of the genus at the Field Museum, the National Herbarium, the Gray Herbarium, the Rocky Mountain Herbarium, the Colorado State Museum, the herbaria of the Universities of Colorado, California, and Washington and of Leland Stanford University, Pomona College, the Oregon Agricultural College, and the private herbarium of W. L. Jepson were studied, in part by loan, in part by visit to the places concerned. Reference is not made to all herbarium material examined. Full citation of specimens is given, however, when the citation concerned is of particular historical interest, when geographical ranges are extended, or for other cogent reasons.

The author is indebted to the curators of the herbaria in which material has been studied or from which loans have been made;

[1] An investigation carried out at the Missouri Botanical Garden in the Graduate Laboratory of the Henry Shaw School of Botany of Washington University and submitted as a thesis in partial fulfilment of the requirements for the degree of doctor of philosophy in the Henry Shaw School of Botany of Washington University.

[2] Issued September 28, 1925.

it was only through their considerate coöperation that so representative a collection of the genus was brought together. He is particularly indebted to Dr. George T. Moore, Director of the Missouri Botanical Garden, for the privileges of the splendid library and herbarium of that institution, and especially to Dr. J. M. Greenman whose helpful advice and unfailing courtesy have both aided the progress and added very greatly to the pleasure of the work.

History of the Genus

Michaux,[1] in 1803, described and illustrated a certain plant which he named *Pycnanthemum Monardella*, the habitat of which was said to be the high mountains of Carolina. The corolla was neither described nor illustrated and in an observation at the end of the description it was stated that the plant was of the habit of *Monarda fistulosa* and that neither it nor the species immediately preceding it were strictly congeneric with the other members of the genus to which they were there assigned. The species referred to was *Pycnanthemum montanum* Michx.

Bentham[2] later made use of the suggestion contained in Michaux's comment and established the genus *Monardella*, using for the generic name the specific designation employed by Michaux. He renamed Michaux's plant *Monardella Caroliniana* and included within this new genus the second doubtful species, *Pycnanthemum montanum* Michaux, which was renamed *Monardella montana*, and three previously undescribed plants collected by Douglas in northwestern America, which were named *M. odoratissima*, *M. undulata* and *M. Douglasii*. In describing the renamed species, *M. Caroliniana*, Bentham referred to it the plant described by Michaux and a plant described by Elliott,[3] repeating their descriptions with quotation marks but giving no indication by the customary abbreviation, "v.s.," that he had seen their specimens. On the contrary, he says: "*Pycnanthemum Monardella* Pursh seen in Lambert's herbarium is very similar to

[1] Michaux, A. Flora Boreali-Americana 2: 8, *pl. 34*, 1803.
[2] Bentham, G. Labiatarum genera et species, p. 331. 1834.
[3] Elliott, S. Sketch of the botany of South Carolina and Georgia 2: 81. 1824.

Monarda fistulosa but the corolla is wanting; thus also in Michaux's drawing; I have not seen Elliott's specimen." [1]

Fourteen years later, Bentham,[2] who in the meanwhile had seen additional material not available at the time of the first revision, definitely referred *Pycnanthemum Monardella* Michx., which he had renamed *Monardella Caroliniana,* to synonymy with *Monarda fistulosa* L. and remanded *Pycnanthemum montanum* to the genus to which it had been assigned originally. Considering the extreme paucity and fragmentary nature of the specimens with which he worked and the similarity of the calyces of *Pycnanthemum montanum, Monarda fistulosa,* and *Monardella odoratissima,* the previous error is not to be wondered at. As reconstituted in 1848 the genus included four species of closely related plants, namely, *Monardella odoratissima, M. undulata, M. Douglasii,* and *M. villosa,* nor was a species of *Monardella* as at present known or as known to Bentham, included in any other genus by him. The genus thus described and constituted was accepted by Gray[3] who enlarged it by the publication of six new species and divided it into two sections. Later authors having to deal with the group accepted it in the same sense.

In 1906 Greene[4] reviewed the history of the genus, as outlined above, but went no further than the original monograph of Bentham, and in conclusion made the following statement: "And while later authors have remanded the type of Monardella to an older genus and an older species even, the name has been retained for what is now a large genus of western plants. The viciousness of this method in nomenclature I long ago attempted to point out; and I here, after long delay, propose a new name for the western genus: a name made out of the old *Monardella,* that is *Madronella.* I shall not attempt to transfer more than a portion of the species, but here is a considerable number of them, placing first in order what should be the type of the genus." There followed a list of the species described by Bentham, Gray,

[1] "Species dubia. *P. Monardella* Pursh! in Herb. Lamb. *Monardae fistulosae* simillima est, sed corolla desunt; sic etiam in icone Michauxiana; plantam Elliottianum non vidi."

[2] Bentham, G. in De Candolle's Prodromus systematis vegetabilis **12:** 191. 1848.

[3] Gray, A. Proc. Am. Acad. **11:** 100. 1876.

[4] Greene, E. L. Leaflets of Bot. Obs. and Crit. **1:** 168. 1906.

and Greene, at the beginning of which was the species *M. odoratissima*.

By the phrase "type of *Monardella*" Greene referred to the species *Monardella Caroliniana* which was the first cited by Bentham. Even had Bentham been familiar with the more recent concept of a "type" it is very doubtful that he would have chosen as the type of a new genus a plant which he had not seen and which he termed "species dubia." Furthermore, by reason of the fact that Bentham himself, as early as 1848, and not "later authors," as erroneously stated by Greene, limited the genus as at present understood, and since the genus was accepted in this sense for fifty-eight years without question, the action of the latter is indefensible. It may be further observed that the original complete and expressive generic diagnosis, based upon a few battered plants, is still exactly applicable to the genus which has been enlarged at least fivefold in number of valid species. The adoption of *M. odoratissima* as the generic type-species was a desirable step because it was the first described of the true Monardellas and because it is the most widely distributed of any of the species.

Since 1906 the names *Monardella* and *Madronella* have both been in use to describe the same group of plants, and the species may be found listed under both names in the 'Index Kewensis.' Since the publications of both Bentham and Greene are not readily accessible, no small amount of confusion has been occasioned.

The first subdivision of the genus, as already mentioned, was by Dr. Gray, in 1876, in a synopsis in which he described as one section "*Macranthae laxiflorae nempe floribus in capitulo laxiusculo sat magis minus numerosis: corolla e calyce longe exserta: antherae loculis ovali-oblongis divaricatis: perennes,*" including therein *M. macrantha* and *M. nana*, and a second group "*Densiflorae et multiflorae: calyce* ¼ *to* ⅓ *pollicari: antherae loculis brevioribus minis divaricatis.*" These subdivisions were adopted by Briquet[1] in his presentation of the family in 'Die Natürlichen Pflanzenfamilien' under the name *Macranthae* and *Pycnanthae*, a ter-

[1] Briquet, J. in Engler u. Prantl, Die Natürlichen Pflanzenfamilien. **IV**. 3a. 309. 1896.

minology which was followed by Abrams[1] in his revision of the southern California species of *Monardella.*

Morphology

The Monardellas are either annual or perennial. The annual species are erect, herbaceous plants from six inches to two feet in height, arising from a short tap-root from which spring small lateral rootlets. They are, for the most part, plants of semi-xerophytic habit, the leaves being few, small, rather thick, and variously pubescent. The stems are columnar, obscurely four-angled, slender and branched. The character of the branching is of two kinds, terminal or basal. In the first type as illustrated by *M. candicans* or *M. lanceolata* the branches occur chiefly in the upper axils and are widely divaricate, but ascending, and when in full flower form thus a corymbose group of inflorescences. The second type, as illustrated by *M. Breweri* and *M. exilis,* are branched throughout with the principal branches arising near the base of the stem and ascending more or less parallel to it, being themselves either simple or branched. Both types may be seen in the same species, yet under the ordinary conditions of its habitat a given species is characterized by one type.

The leaves of the annuals show little diversity, being of about the same range of size, lanceolate or oblong, entire, shortly petiolate and spreading, and subcinereous with a short close pubescence or glabrate. The chief exception to this condition is shown by the leaves of *M. undulata.* Here the leaves are oblanceolate and markedly undulate or crisped. The venation is pinnate but rather obscure in the annuals.

The stem of the perennials is generally decumbent, occasionally trailing or even somewhat subterranean, as in the case of *M. macrantha.* It is apparently, in many cases at least, a modification of the first stem to be formed, which after flowering dies back only part way to the base. In some species, as in *M. hypoleuca,* the stem may become elongated to several feet, trailing over and supported by brush. The branches arise from the stem, being either distributed along it in a candelabra-like way,

[1] Abrams, L. R. Muhlenbergia 8: 26–44. 1912.

as often seen in *M. linoides*, or else from a well-defined crown as in *M. odoratissima.* It is evident from the nature of the distribution of the perennial species that the habit is frequently a function of quite varied environmental conditions. Like the annuals, the stem of the perennials is provided with a stout taproot. In old plants the bark, which is smooth and brown, becomes checked and flakes away. The branches are variously pubescent above and glabrate below. They may be either erect, ascending, or decumbent, and either simple or branched, but when branching the secondary branches are short, slender, and seldom fertile. Their habit is more or less characteristic of the species.

As contrasted with the leaves of the annuals, the leaves of the perennials are diverse in form, covering, and size. They may be entire or serrate upon a single plant. In general, however, there is a certain aspect about the leaf which permits its identification with a certain species. In shape they may vary from ovate to oblong, the extremes being, on the one hand, rotund, and, on the other, linear-oblong; they are more frequently petiolate than sessile, the petioles being always short in proportion.

The pubescence of the stem and leaves is equally diverse, being silky-villous, woolly-villous, tomentose or hirsute, canescent or cinereous, or may be very minute but dense, so as to cause a silvery or glaucous appearance. The pubescence is of value in distinguishing subspecies but by reason of its response to the environment must be used with care as a basis for specific differentiation. In general a close puberulence or pubescence is characteristic of the forms of the drier interior, while forms exhibiting a looser, more villous or tomentose covering are to be found in closer proximity to the coast-line. The pubescence of the stem is usually retrorse, but may occasionally point upwards. In a similar way the trichomes of the upper surface of the leaves may point either to the distal or proximal end. This fact has been utilized by Abrams in separating two closely related forms, but from a microscopic examination of copious material it is clear that this character cannot be relied upon to effect other than an arbitrary separation, for it has been observed that in numerous cases the pubescence of the lower part of the leaf may point downward, while that of the upper part may point upwards. At the same time material from a given locality which is strikingly similar in other respects and hardly to be separated may exhibit both types of pubescence characters as shown by the collection of *M. linoides* made by Purpus on Pah Ute and Argus Peaks. A similar condition has been observed in other mints, as, for example, the coastal forms of *Monarda punctata*.

Yellowish glandular punctations are common upon the leaves of the genus, and in some cases stalked glands may be present. The former are more apparent in some plants than in others, often being obscured by the pubescence. The punctations vary somewhat in dried material, chiefly in the degree to which the leaves become pitted. Their size remains fairly constant with a certain degree of variation in the frequency of their distribution. No use of them has been made herein.

The inflorescence of the genus consists of a compact globose head or glomerule of flowers borne terminally upon the branch and subtended by a series of bracts arranged in more or less opposite pairs. Rarely, two glomerules may be present, a smaller one above the first. This has been observed only in *M. undulata* and in *M. odoratissima.* The flowers are attached by a short pedicel to a small disc-like structure which terminates the branch and which may be considered a foreshortened and modified cyme. Only the outermost flowers are bracteate. The bracts are of an oval or lanceolate shape and appear membranous or foliaceous, with a pinnate venation. They are of especial value in specific diagnosis, since their form and consistency, their size and arrangement relative to the calyces, their venation, and the nature of the margin and pubescence are accompanied by well-marked differences in other parts and within a given group of closely related forms remain fairly constant throughout a wide range of distribution.

In consistency the bract varies from a white papery membranous structure to a fleshy green form hardly separable from the leaves of the stem. In any case the outermost are more likely to be foliaceous than the inner. In some species the bracts are erect and sheathe the cluster of flowers; in some, however, they are partly or wholly reflexed. Few exceed the calyces by more than half their length, and few are shorter than the calyces.

While the venation is ultimately pinnate in all, in some the mid-vein is foreshortened to such an extent that it appears to be wanting, and the lateral veins appear parallel. Frequently the margin, which in most species is firm and green, becomes thin, scarious, and whitened.

The calyx is tubular, in most species one-fourth to one-fifth as wide as long, and bilabiate in most but appearing equidentate on casual examination. The bilabiate condition of the calyx-limb is especially noticeable in the subgenus *Macranthae.* The teeth are somewhat shorter than the width of the tube and narrowly triangular in form. The veins of the calyx are prominent but hardly costate, giving it a striate appearance. While the aspect of the calyx is much the same throughout, a careful study reveals the fact that numerous small differences may be observed and that within the limits to be expected are quite constantly associated with other characters. This is especially true of the arrangement and number of the veins which vary from 10 to 15 in the genus, and the conformation of the calyx-teeth and their margins.

In the simplest case, the veins of the calyx terminate at the apex of each tooth and at the base of each sinus, being ten in number. In calyces with thirteen veins each of the two shallower sinuses is provided with only one vein, while the three additional veins are paired with each of those in the remaining sinuses. In calyces with fifteen veins, in addition to the five veins terminating in each tooth, each sinus is the terminus for a pair of veins. A species characterized by calyces with ten veins will usually show within the same glomerule calyces with eleven veins, rarely with twelve; calyces with typically thirteen veins will be found to vary between twelve and fourteen; those with fifteen will vary to fourteen, rarely less. If a number of flowers from a given species be examined the number of veins in the calyces will be found to center about one of the three modes indicated.

In some species the margin of the tooth, which is ordinarily bordered by a vein, becomes scarious and white and in a single species prong-like.

The pubescence of the calyx is fairly constant but not sufficiently so to offer a means of infallible specific diagnosis in the case of the perennials. This was shown to be the case by a microscopic study of various closely related forms, judged by other considerations, which nevertheless showed under the microscope a considerable difference in the degree to which certain trichomes might be developed, thus causing an apparent difference in kind when examined with a lens or the naked eye. The character is of value in separating subspecies, however.

In the nature of the corolla the genus presents several differences not readily observed unless subjected to careful examination. The subgenus *Macranthae* is characterized by the unusual proportions existing between the corolla-tube and the limb, on the one hand, and the corolla-tube and the calyx, on the other, as well as the fact that the lobes of the corolla taper evenly to a point. In the case of the subgenus *Pycnanthae,* the corollas are much the same size, the size being nearly constant for a given species, yet present valuable diagnostic indices in the degree to which the lips are lobed and the shape of the lobe. The corolla is definitely bilabiate, the posterior lip being two-lobed, the anterior three-lobed. The lobes are linear-oblong or linear-lanceolate. The shape of the lobes, whether nearly equal throughout and ribbon-like or whether tapering noticeably, whether blunt or whether rounded to a point, and the degree to which they are coalesced, are characters which have been found fairly constant for most of the species and are of help in specific differentiation. The degree of exsertion of the corolla-tube from the calyx is also of value but must be employed with caution. The presence or absence of a retrorse pubescence within the tube at the base of the stamens may be used as a specific character but when present such a pubescence is variable.

The stamens are four in number, the two anterior exceeding the posterior. They are attached to the corolla just within the throat, their position varying but little. The filaments are fairly stout and present little or no difference. They are often retrorsely hispidulous but when this condition is present it is quite variable on the same plant, and not infrequently a single filament may be pubescent nearly to the apex while the remaining three are glabrate.

The anthers and connective and the relation between the two serve admirably in some cases as characters for specific differentiation, and in the case of *Macranthae* are subservient to subgeneric differentiation. The anther-sacs are two, subparallel or divergent, being subconfluent above when markedly divergent. In the annuals the degree of divergence, which is a function of the development of the connective, is in general less and the connective is less developed than in the perennials. In the former the shape of the anther-sac after dehiscence, together with the appearance of the connective, especially the conformation of its lower margin, was found to be somewhat diverse among the species but constant for a given species. In the perennials, however, the connective presents much the same appearance in all the species, being approximately equilateral when viewed from the front, except in the subgenus *Macranthae* where the angle of divergence approaches that of 180 degrees.

The ovary is four-parted, forming at maturity four smooth brown nutlets, basally attached, oblong or oval in outline and somewhat flattened. These are about two millimeters in length and present few differences. The style is about the length of the corolla, unequally bifid at the top and glabrous.

Considering the genus as a whole, the following morphological criteria have been found most trustworthy in diagnosis of the species: the habit and foliage within certain limits, the texture of the bracts, the number of the calyx-nerves and the form of the teeth, the conformation of the lips of the corolla and the structure of the anthers.

Relationships and General Distribution

The species of *Monardella*, while forming a precisely circumscribed and very natural group as a genus, are not themselves so easily capable of definition. This is particularly true of the perennials, where very considerable degrees of variation may occur on a single individual. In the absence of copious material for study, or through failure to consider variations in connection with their geographical relationships, or by reason of tendencies to magnify differences between individuals while neglecting or overlooking equally important likenesses, many of the variants which may be found in the perennials have been described as species. If these variants, however, are studied in connection with one another and in relation to their environment and geographical and ecological distribution, the distinctions upon which such species rest will be found to effect no more than an arbitrary delimitation. Considered alone, the type specimens of these species offer quite ample grounds, in many cases, for designation as species. Considered in connection with numerous intergrading and connecting forms, considered as living plants and not as artifacts, followed from one area of occurrence to the next throughout the range as organisms in contact with an ever-changing environment, such variants will be found to merge imperceptibly.

The criteria which had been described above have been found to offer a means of separating the genus into certain groups which are rather clearly defined, and which have a characteristic and natural distribution, and which suggest at the same time a probable phylogenetic sequence. These groups have been termed species and in general correspond to the concept known as the Linnaean species, a category of great value in demonstrating ecological, geographical and morphological relationships.

To insist that such a category is homogeneous would doubtless lead to error in numerous cases and is contrary to well-known evidence; to ignore the variations which occur within such a group would serve only to prevent a further understanding of it; to recognize that such a group may be heterogeneous but nevertheless that its members are more closely related to each other than to the other members of the genus and to so name these elements that the relationship may be apparent in the name, just as the relationship between species is indicated in the common generic name, has seemed to the writer the most helpful course in the case of the genus *Monardella*.

To determine the exact relationship existing between the elements of a species requires detailed analytical and synthetical experiment. Such a course has not been possible in the present study. Proceeding on morphological grounds an attempt has been made to characterize the components of the polymorphic species in so far as these components appear to represent certain evolutionary tendencies within the species. Such categories have been termed subspecies, in the sense that the groups thus designated merge imperceptibly, but when taken in the average or typical aspect occupy a definite and characteristic habitat. It is not without caution that the term subspecies has been thus employed in the absence of genetical data and garden observation and experiment. By way of illustration it may be assumed that the several subspecies comprising the species *M. villosa* are derived from a common stock which was at one time in occupancy of the approximate area now occupied by the species. By reason of isolation, or through climatic changes in geological time, or for other reasons, the species once homogeneous may be thought of as gradually differentiating into several closely related groups, each with a characteristic habitat. These groups would form the subspecies herein described, each exhibiting a tendency of evolution from a common stock, which might very well be still extant. Such subspecies do not vary merely by the presence or absence of a single given character, but rather in the accumulation of numerous small differences. The category known as the variety has been employed to designate those forms which differ from the typical, principally in the presence or absence of one or two morphological characters of the magnitude commonly employed in taxonomy. Such forms, as herein understood, do not possess a characteristic geographical or ecological distribution distinct from the typical. It has been possible thus far for the writer to bring only *M. odoratissima* under cultivation. From the behavior of other *Labiatae* grown from seed or from transplants from the field, particularly of the genus *Monarda*, it is believed that the subspecies as herein described will be found to be racially distinct and not impossibly a complex of variants which differ genetically, the subspecies representing the modal points of such a complex.

Related groups.—Each of the four most widely distributed species, *M. macrantha, M. lanceolata, M. villosa*, and *M. odoratissima*, may be considered a center about which the other species can be arranged according to resemblances. Four species, three of which are endemic, are more or less intermediate or of uncertain relationship. The groups resulting from such an arrangement are herein designated as "Sections" and are as follows:

Section I

M. macrantha
?*M. Palmeri*

Section II

M. lanceolata
M. Breweri
M. Pringlei
M. leucocephala
M. candicans
M. exilis
M. Douglasii
?*M. undulata*

Section III

M. villosa
M. lanata
M. hypoleuca
M. viridis
M. saxicola
?*M. cinerea*
?*M. thymifolia*

Section IV

M. odoratissima
M. linoides

The sections are all closely connected, yet the greater and more significant differences of the first, as contrasted with the remaining three, have led to its segregation as the subgenus *Macranthae*. *M. Palmeri* is apparently an intermediate form. Of the remaining three sections, the second, while closely knit and showing definite lines of divergence, is still too closely connected with the other two to be separated as a subgenus. A brief comparison of the morphology of each of these groups will be made in order to indicate the possible affinities. The conclusions drawn from such a comparison are shown in fig. 1.

The habit of the subgenus *Macranthae* is not essentially different from that of the subgenus *Pycnanthae* but the stem is slender and more or less rhizomatous and semi-subterranean, giving rise to either decumbent or ascending branches, usually few in number and located at the distal end. In those forms which occur in acerose forests the stem trails along beneath the detritis of the surface layer. In the forms of more xerophytic habit this distinction is partly lost, and in *M. macrantha* var. *arida*, the variety most adapted to a xerophytic habitat, a definite crown is formed and the branches often rebranch at the base, thus forming a small tuft: the habit, in other words, of the subgenus *Pycnanthae*. It may be said, then, that there is a tendency on the part of the most restricted of the species of this subgenus to assume the growth-form which characterizes the perennials of the subgenus *Pycnanthae*. *Macranthae* are further characterized

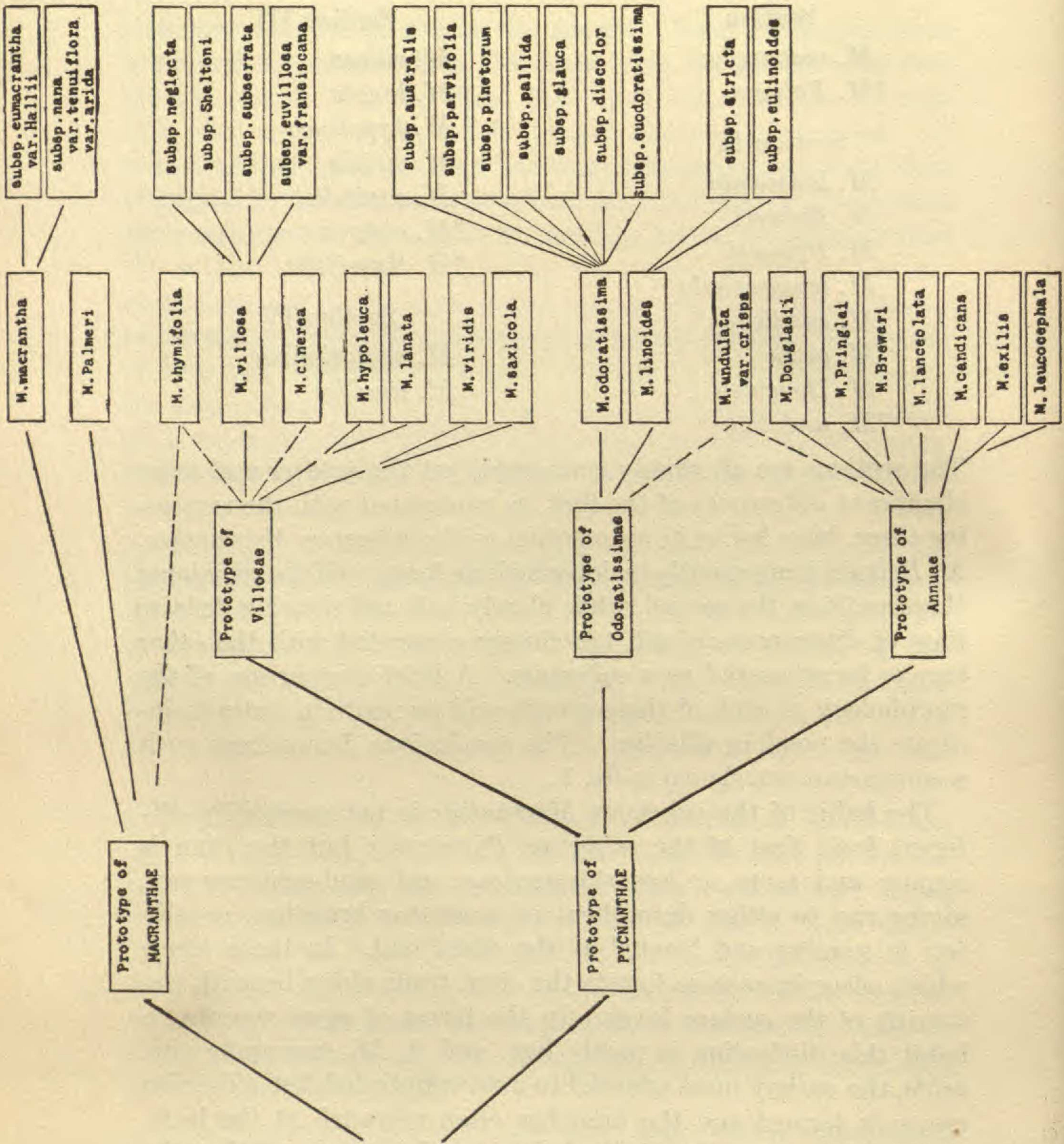


Fig. 1. Diagram of relationships.

by a more coriaceous leaf than is generally the case in *Pycnanthae*. In form and size of leaf there is great diversity within the group, even on individual plants, yet all are united by the possession of a hardly definable aspect which suggests a common relationship.

In addition to the vegetative habit, the habit of the inflorescence is distinctive. While fewer-flowered, given equal opportunity for development, the inflorescences in *Macranthae* are larger in proportion to the plant, due in part to the larger calyx and corolla, and give a top-heavy appearance to the branch in typical cases. The arrangement of the flowers in the glomerule is also looser. However, the greatest difference between the two subgenera lies in the flower. The calyx is actually larger in *Macranthae* and different in proportion, and the corolla is of different proportions, although in the more reduced forms a casual glance would not distinguish it from the corolla of *M. villosa* for example.

A study of the corolla indicates either a progressive reduction from the large corolla of *M. macrantha* subsp. *eumacrantha* to the small corolla of subsp. *nana* var. *arida*, or a progressive development in the other direction. It is believed by the author that the series is a reduction series; first, because the vegetative habit of the small-flowered species is correspondingly reduced and adapted to the arid habitat; second, the corollas themselves strongly suggest a reduction form, whence the specific adjective; again, in the progressive color changes which accompany the reduction in size certain characters are lost rather than gained.

In resumé, then, we may state that *M. macrantha* is the least modified of the species of the first subgenus and hence most like the hypothetical common precursor of the two subgenera. *M. Palmeri*, a restricted endemic, is intermediate between the subgenera. There may be observed in the subgenus two evolutionary tendencies, namely, the adoption of a more compact growth-form and a reduction and modification of the flower and foliage, both attendant upon occurrence in a more arid habitat.

The annuals form a well-defined and interesting group. They are all of essentially the same stature, growth-form, and foliage, except *M. undulata*, and differ principally in the characters of the inflorescence, namely, in the texture of the bracts and in the degree to which the corolla is bilabiate. By reason of the fact that *M. lanceolata* is least differentiated, it is looked upon as being most like the common progenitor of the annuals. From this basis it is possible to trace three suggestive lines of divergence. The first to be considered will be that of the bract.

As previously stated, the bract of *M. lanceolata* is less differentiated and not infrequently becomes foliar in nature. It is lanceolate, acute, pinnately veined, green and opaque, but not fleshy. Beginning here one may trace through *M. Breweri, M. Pringlei, M. candicans, M. exilis,* and *M. leucocephala* a progressive reduction of the midvein until the veins appear parallel, apparently arising from the base of the bract, but in reality from a much foreshortened mid-vein. More or less concurrent with the reduction of the midvein is a reduction of the secondary veins, as well as an increasing scarious nature of the bract. In the opposite direction lies a very curious effect. In *M. Douglasii* the midvein and secondary veins have become costate and thickened, the latter becoming confluent on the margin. The intravenous tissue has become homogeneous, translucent or even transparent, and tough, suggesting isinglass. While this would appear an extreme modification it should be noted that in many instances half of the bract may be truly foliar.

Correlated with the differentiation of the bract is a differentiation of the corolla. In *M. lanceolata* the corolla is bilabiate, the lobes of the upper lip being coalesced for two-thirds of its length, the lobes of the lower lip being free nearly to the base. A progression may be observed commencing with *M. lanceolata* through *M. candicans, M. Breweri, M. Pringlei* to *M. exilis* and *M. leucocephala* in which the corolla-lobes become more coalesced until those of the upper lip are free for less than a quarter its length while those of the lower lip are coalesced for about one-third of its length. At the same time the corolla becomes less and less exserted until in *M. leucocephala* it is hardly seen at a casual glance.

Again, the calyx-teeth of *M. lanceolata* are green, lanceolate and acute. In *M. Breweri* and *M. Pringlei* the calyx-teeth are herbaceous still, but slender and not infrequently become slightly mucronate. In *M. candicans* they are herbaceous but frequently scarious-margined. In *M. exilis* the scarious margin is well developed and conspicuous. In *M. leucocephala* the calyx-teeth are terminated by a whitened recurved prong. It should be observed that each of these lines of development is correlated with occurrence in a more arid habitat, and since the plants are annuals, presumably with a shortened vegetative cycle.

M. undulata is a variable species of uncertain relationship, annual in part, suggesting the annuals in some respects, in others more closely allied to *M. odoratissima.* The oblanceolate crisped leaf is unique in the genus.

We may conclude, then, that the annuals of the subgenus *Pycnanthae* form a natural closely knitted group, showing increased adaptation to a more arid habitat. Three correlated lines of divergence may be observed, namely, a progressive modification of the bract, of the corolla and of the calyx. *M. undulata* is of uncertain relationship but lies closest to this section.

The perennials of *Pycnanthae* may be divided rather arbitrarily into two sections by the nature of the bract, whether firm and tending to foliar, or whether membranous. In addition the corolla of the latter group is generally more bilabiate, the upper lip being coalesced to a greater extent than in the former. The first section is typified by *M. villosa,* the second by *M. odoratissima. M. villosa* is regarded as being the least modified of any of the species of this subgenus by reason of the subfoliar nature of the bract, the slight degree to which the lobes of the corolla have become coalesced, the bilabiate condition thus being less pronounced, and because of its generally more mesophytic character. The occurrence of broadly ovate, obtuse, crenate-dentate hairy leaves suggests strongly a relationship to *M. macrantha* var. *Hallii.* Such a conclusion is strengthened by a comparison of the leaves of the endemic *M. thymifolia* which occurs on Cedros Island off the coast of Mexico. Facts of distribution support the assumption that these three species (*M. villosa, thymifolia, macrantha*) taken together indicate the probable nature of the generic prototype.

Section III, as outlined above, is united by the perennial habit, by the rhomboidal crenate-dentate leaves, in general glabrate above and variously tomentose beneath, by the subfoliar or thickened bract, and the little modified corolla. *M. hypoleuca, M. lanata, M. viridis* and *M. saxicola* more nearly resemble each other than they resemble *M. villosa. M. cinerea* and *M. thymifolia* are endemics of uncertain position but most nearly related to *M. villosa.* The latter suggests the subgenus *Macranthae* in the aspect of its foliage. The former suggests *M. odoratissima* in bract character and habit. *M. odoratissima* and *M. linoides*, while more closely related to each other, are nevertheless very close to this section. They have been grouped separately, partly for convenience in illustrating their distribution. Sections III and IV are more heterogeneous than the two preceding and it is more difficult to discern any continuous line of development in them. In general it is true that, with an increasing occurrence in an arid habitat, the leaves progress from ovate and crenate to oblong or oblong-linear and entire and become more thickened and leathery; the bracts from foliaceous become membranous or chaffy; the lobes of the corolla become more coalesced.

A study of the genus as a whole suggests strongly that it is a genus of mesophytic origin which exhibits an increasing adaptation to an arid habitat.

Distribution.—Generally speaking it may be said that Section I occupies the mountains of southern California and northern Lower California; that Section II occupies the less arid parts of the interior valley of California; that Section III occupies the coast ranges of California and southern Oregon, while Section IV occupies the high mountains surrounding the Great Basin. The more detailed distribution may be better obtained by reference to the accompanying charts than from a verbal description here.

In view of previous discussion relating to isolation as a factor in the origin of species[1] it is desired to call attention to an apparent correlation between the degree of relationship existing between certain components of the genus and the degree to which these components are associated geographically.

The species in which the widest range of variability is found and in which the units are least readily defined is *M. macrantha*. It is also a species of considerable geographical range, extending as it does from the Santa Lucia Mountains, near the Monterey peninsula to San Pedro Martir in Lower California. The variations in foliage and pubescence are considerable but are surpassed by

[1] Jordan, D. S. The origin of species through isolation. Science N.S. **22**: 545–562. 1905; Lloyd, F. E. Isolation and origin of species. *Ibid.* 710–712. 1905; Abrams, L. R. Theory of isolation as applied to plants. *Ibid.* 836–838. 1905; Abrams, L. R. and Smiley, F. J. Taxonomy and distribution of Eriodictyon. Bot. Gaz. **60**: 115–133. 1915.

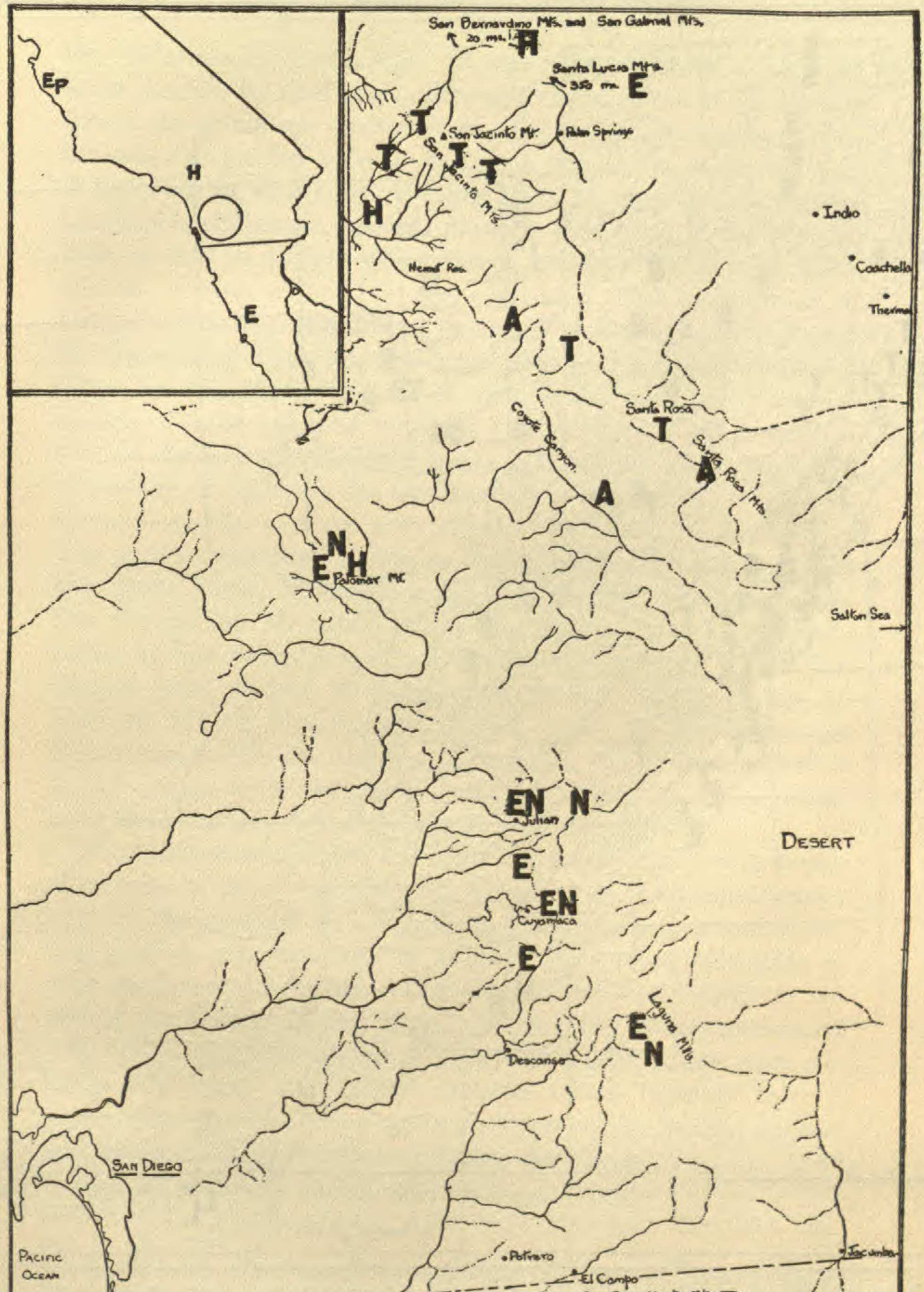


Fig. 2. Map of San Diego County, California, with an insert of southern and Lower California, showing the distribution of *Macranthae;* E, subsp. *eumacrantha;* H, subsp. *eumacrantha* var. *Hallii;* N, subsp. *nana;* T, subsp. *nana* var. *tenuiflora;* A, subsp. *nana* var. *arida;* P, *M. Palmeri.*

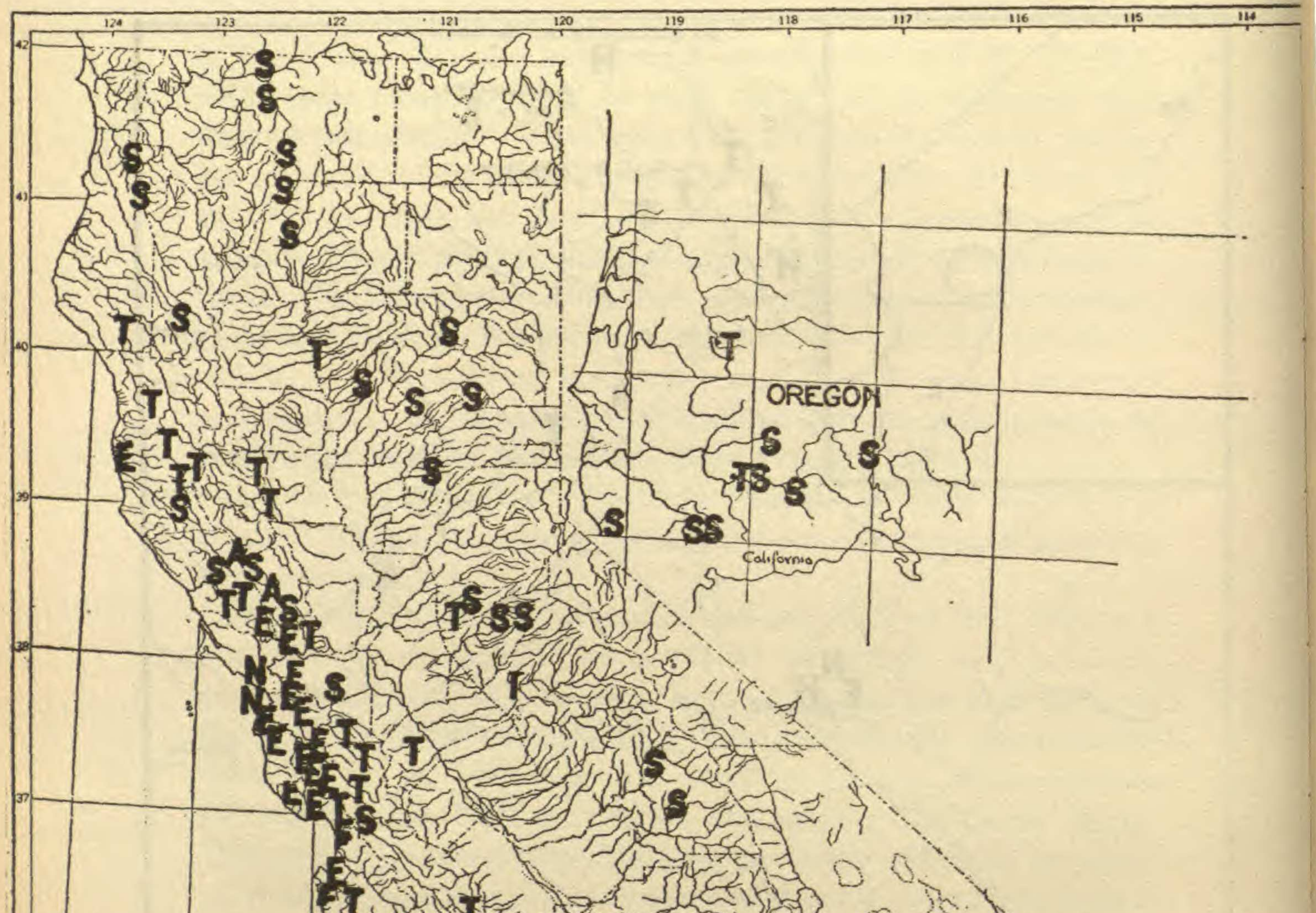


Fig. 3. Map of California and adjacent Oregon (insert), showing distribution of *M. villosa* and allied species: E, *M. villosa* subsp. *euvillosa;* N, *M. villosa* subsp. *neglecta;* S, *M. villosa* subsp. *Sheltoni;* T, *M. villosa* subsp. *subserrata;* H, *M. hypoleuca;* L, *M. lanata;* A, *M. viridis;* U, *M. saxicola;* C, *M. cinerea.*

the variations in corolla size. It was pointed out by Gray[1] and more recently by Hall[2] that, although the extremes in corolla size within the group are most diverse, they are connected by a continuous and graded series. As far as the size is concerned this is true, but as shown by Abrams[3] there is apparently a certain qualitative difference present, namely, the shape of the corolla-tube, as well as a slight quantitative difference in the size of the anther. These differences are correlated with differences in foliage and pubescence so that two fairly well-defined groups may be discerned. These groups were both given specific rank by Gray (as *M. macrantha* and *M. nana*) who later, with the accession of more material reversed his opinion. They were considered distinct species by Abrams. Whether called species or subspecies or varieties, the two groups are very closely connected morphologically and are very closely associated geographically. The group designated herein as subsp. *eumacrantha* is found in the Santa Lucia Mountains, the San Gabriel Mountains, the San Bernardino Mountains, and the mountains of Lower California at San Pedro Martir. In addition it is found in the San Jacinto Mts. at low elevations and in San Diego County on Palomar Mt., in the mountains near Julian, in the Cuyamaca Mountains and in the Laguna Mountains, but in these places is in association with the group designated herein as subsp. *nana*, both forms apparently occurring in the same locality.

The subspecies *nana*, on the contrary, is confined largely to the mountains of San Diego County, occurring in the typical aspect only in the localities in which is also found subsp. *eumacrantha*. The possible exception may be found in the Orcutt collections at Japa in Lower California. The author has been unable to ascertain the location of this place. While being always associated with subsp. *eumacrantha*, when in typical aspect, subsp. *nana* exhibits two fairly well-defined varieties which together have a separate geographical distribution, being found in the San Jacinto and Santa Rosa Mountains at higher elevations.

[1] Gray, A. Syn. Fl. N. Am., ed. 2, 2[1]: 459 (suppl.). 1886.

[2] Hall, H. M. A botanical survey of San Jacinto Mountain. Univ. Calif. Publ. Bot. 1: 109. 1902.

[3] Abrams, L. R. The Monardellas of southern California. I. Muhlenbergia 8: 26. 1912.

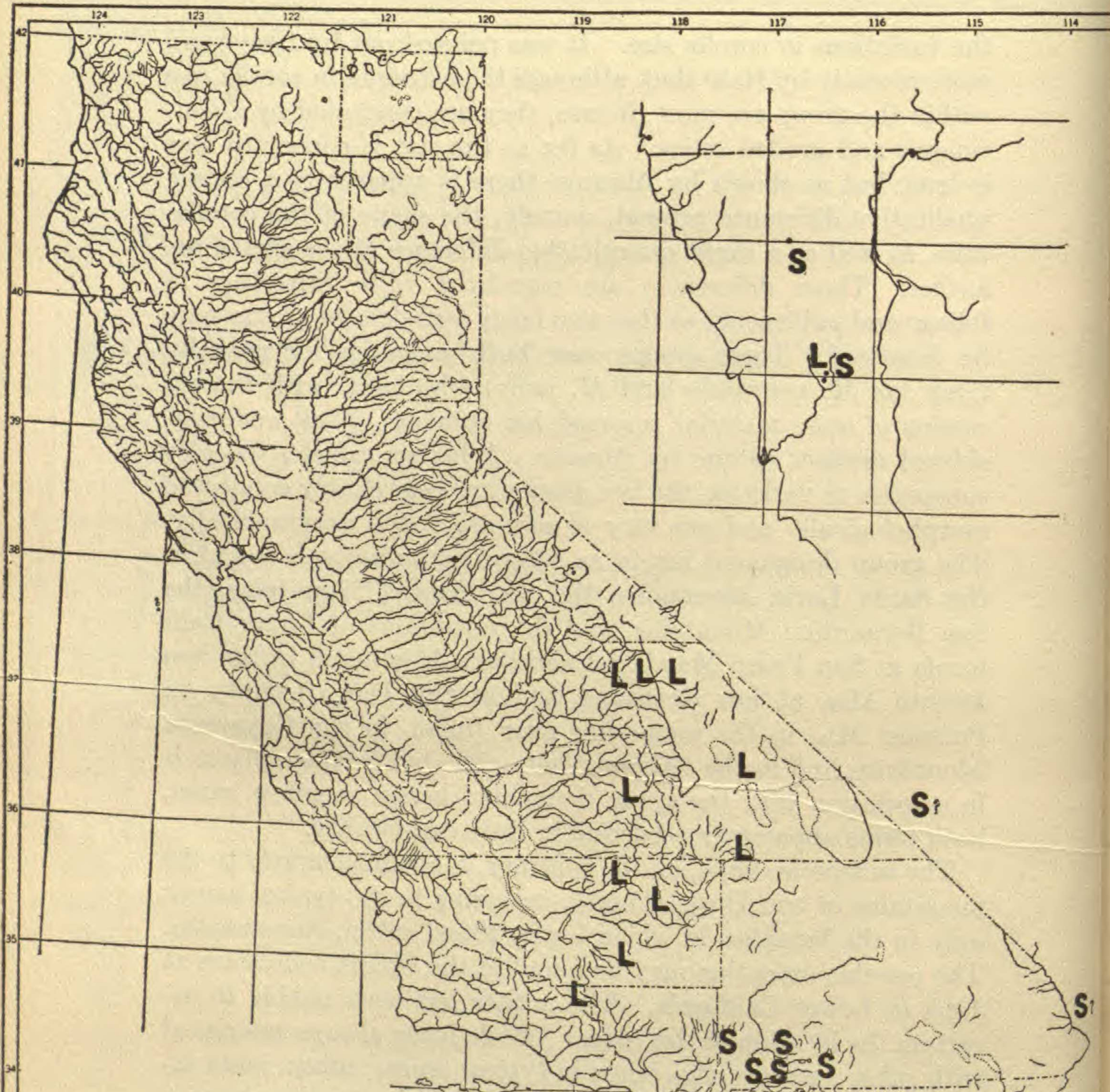


Fig. 4. Map of California and adjacent Lower California (insert), showing distribution of *M. linoides:* L, *linoides* subsp. *eulinoides;* S, *M. linoides* subsp. *stricta.*

Since subsp. *nana* and its varieties *tenuiflora* and *arida* are almost certainly derivatives of subsp. *eumacrantha* or a similar form now extinct and since the relationship is still very close it is of interest to find that the range of the former subspecies coincides with a limited portion only of the range of the latter subspecies and of particular interest to note that the chief deviation from the range of subsp. *eumacrantha* is found in the two most highly adapted varieties, namely, var. *tenuiflora* and var. *arida*.

The section which is next in order in the closeness of the relationships of its components is section IV, composed of *M. odoratissima* and *M. linoides*. This group is also of the widest geographical distribution. As treated herein the first-named species is divided into seven subspecies, the second into two subspecies. In actuality the group represents an almost unbroken series of intergrading forms, with but a poorly defined hiatus between *M. linoides* and *M. odoratissima*. While the extremes within *M. odoratissima* are much less than in *M. macrantha*, nevertheless the modal points within the range of variation stand out more clearly than is true of the varieties and subspecies of that species. These modal points furthermore represent plants with characteristic geographical habitats which are distinct but contiguous. It is chiefly in the intermediate geographical regions that intermediate morphological forms are found. The same is true in the case of *M. linoides*.

M. villosa and its allies present a condition where differentiation has proceeded further, where the connecting forms have disappeared and where the related species are separated by definite and sometimes considerable geographical barriers. At the same time there is occurring in *M. villosa* the same differentiation with respect to geographical habitat which has apparently taken place in the formation of this species and its allies. *M. villosa* extends from northern San Luis Obispo County to southern Oregon, never being found east of the Sierra Nevada as far as known. Its subspecies intergrade but occupy characteristic and contiguous geographical habitats. Just as in *M. odoratissima*, the intermediate morphological forms are intermediate geographically. The only other ally which is found in this range is *M. viridis*. *M. viridis*, however, is most nearly connected to *M. saxicola* which is found

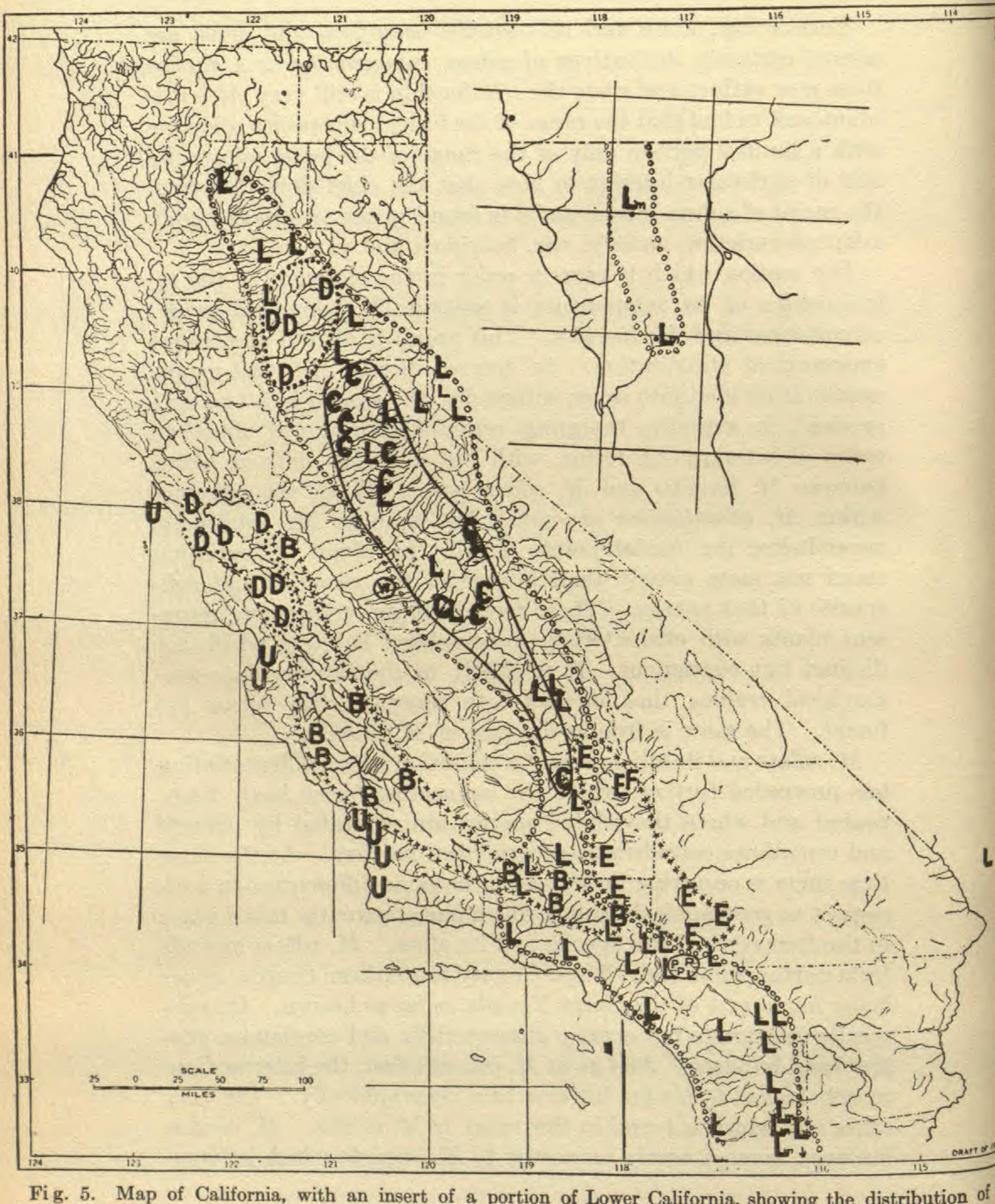


Fig. 5. Map of California, with an insert of a portion of Lower California, showing the distribution of t annuals: L, *M. lanceolata;* Lm, *M. lanceolata* var. *microcephala;* B, *M. Breweri;* C, *M. candicans;* E, *M. exilis,* *M. Pringlei;* W, *M. leucocephala;* D, *M. Douglasii.*

in the San Gabriel Mountains. *M. lanata* and *M. hypoleuca* are more closely connected to each other than to any other species. *M. cinerea* and *M. thymifolia* are species of uncertain relationship, but most nearly allied to *M. villosa.* They are very restricted in distribution, the former being found only on Mt. San Antonio (Mt. Baldy) in southern California, the latter on Cedros Island off the coast of Lower California.

The same situation exists in the case of the annuals and is even more clearly seen there. As already stated it appears that *M. lanceolata* is most nearly like that prototype from which these species have evolved. It has also the widest range, from Lower California to the Tehachapi, thence along the Sierra Nevada to Shasta County. Within this range are also to be found the distributional areas of three other species which are themselves clearly separated. With the exception of this overlapping on the part of *M. lanceolata*, the ranges of the other allied species, seven in number, are distinct. Of these, two, namely, *M. leucocephala* and *M. Pringlei*, are very restricted in distribution, the former being found on the plain of the San Joaquin River near Merced, the latter in the Jarupa Hills near Colton. The areas of distribution of all the species save *M. Douglasii* appear to be continuous. In the case of this species, however, one area in the Coast Range and foothills of the Bay Region is separated from the second in the foothills of the Sierra in Yuba, Butte and Plumas Counties by the valley floor of the Sacramento River. There was found no apparent morphological difference between the inhabitants of the two regions. One specimen of *M. lanceolata*, very typical in aspect, was found to have been collected in "Mont. Cr." Arizona. The location of this place could not be ascertained. If the label was correct this would represent an unusual extension of the species. *M. undulata,* which is most nearly allied to the annuals, is confined to the coastal hills ranging from Santa Barbara County to Point Reyes. There is nothing to suggest that its area of distribution is not continuous.

It is apparent from the facts presented above that there does exist in the genus *Monardella* a correlation between the degree to which its components are related and the degree to which they are separated geographically. It is strongly indicated that such groups of species as the annuals or the allies of *M. villosa* have arisen from a common stock which was at one time in possession of the territory now occupied by the group as a whole and that such species were formed after isolation of the chief variants within this common ancestor. It is not inconceivable that even moderate climatic changes on the Pacific slope would effect a similar segregation of the subspecies of *M. odoratissima* into forms which, after a period of isolation, would appear as distinct species of distinct range.

Center of dispersal.—Adams,[1] adopting suggestions from previous authors, has proposed the following criteria for the determination of centers of dispersal, in the absence of paleontological evidence:

"1. Location of greatest differentiation of type.
2. Location of dominance or greatest abundance of individuals.
3. Location of synthetic or closely related forms (Allen).
4. Location of maximum size of individuals (Ridgway-Allen).
5. Location of greatest productiveness and its relative stability, in crops (Hyde).
6. Continuity and convergence of lines of dispersal.
7. Location of least dependence upon a restricted habitat.
8. Continuity and directness of individual variations or modifications radiating from the center of origin along the highways of dispersal.
9. Direction indicated by bio-geographical affinities.
10. Direction indicated by annal migration routes, in birds (Palmén)."

More recently Livingston and Shreve[2] have modified these somewhat and have suggested the following as further criteria applicable to plants:

1. Location of most rapid rate of growth.
2. Location in which a form is accompanied by the largest number of individuals which are specifically distinct but of the same growth form.

In the present case it has seemed desirable to restate these criteria and to limit the group under immediate consideration to

[1] Adams, C. C. Southeastern United States as a center of geographical distribution of flora and fauna. Biol. Bull. **3**: 115–131. 1902.

[2] Livingston, B. E. and Shreve, F. The distribution of vegetation in the United States as related to climatic conditions. Carnegie Inst. Wash. Publ. 284: 392. 1921.

one showing close affinities and a common growth-form. In the case of *Monardella* it seems not improbable that the annual species have had a more recent origin than the perennial stock; if this is true the center of dispersal need not necessarily coincide with that of the perennial species. Since the annuals form a natural group of close affinity the criteria were applied to them separately. The species were considered units. Each of the groups of perennials outlined above was similarly treated. By means of such integration a closer approximation may be had to the center of dispersal of clearly related categories. If the centers of dispersal of such categories coincide, greater confidence may be felt in stating the center of dispersal for the larger group. At the same time secondary centers of dispersal may be disclosed which would otherwise lie hidden.

CRITERIA FOR DETERMINATION OF A CENTER OF DISPERSAL.

Determination of:

1. Region inhabited by the most units of the category studied.
2. Region inhabited by the units which are most diverse morphologically.
3. Region indicated as the focus of geographical paths of dispersal.
4. Region indicated as the center of dispersal of the units least modified.
5. Region where the most units are most successful as judged by:
    a. greatest abundance of individuals,
    b. greatest reproductive activity,
    c. greatest vegetative vigor,
    d. least dependence upon a restricted habitat.
6. Region indicated by known center of closely allied categories.
7. Region indicated as the center of evolutionary tendencies in development as shown by progressive modification or increasing adaptation to a certain habitat.

These criteria were applied independently to the four sections outlined in preceding paragraphs. Since the application of certain of these criteria presupposes a field study it was impossible to draw any conclusions regarding these. A more extensive study of the species in the field, following the lines of variation of each species, is necessary for a satisfactory solution. From the conclusions which it was possible to draw it would appear that the present center of dispersal of *Monardella* lies in California south of the 35° parallel. There appear to be two subordinate centers, each of which corresponds to the center of distribution of a subgenus: *Macranthae* centering in the mountains of San Diego County, *Pycnanthae* in the mountains and foothills of Los Angeles and Ventura Counties. The results obtained are shown in table I.

It is generally believed that the western margin of the North American continent had assumed substantially its present outline by the beginning of the Eocene,[1] which was marked by a tropical or subtropical climate as far north as Puget Sound.[2] With the Pliocene began a period of elevation of the continental margin which reached its climax during the glacial period of the Pleistocene, followed by a subsidence to somewhat less than its present elevation.[3] These movements and attendant climatic changes affected profoundly the existent flora and fauna which by this time had assumed a distinctly modern type.[4] There seems to be evidence that in western North America the increase in elevation varied at different times from 1500 feet along the coast[5] to 3000–6000 feet in the Sierra and Cascade Ranges and in the interior basin.[6]

An abundant precipitation and a corresponding increase of snowfall resulted in an extensive glaciation which reached southward along the Cascade Range into southern Oregon and the Sierra Nevada of California and was also present in the Rocky Mountains and the Wasatch Range of Utah.[6, 7, 8] This, the so-

[1] Schuchert, C. Paleogeography of North America. Bull. Geol. Soc. Am. **20:** 427–606. 1910.

[2] Smith, J. P. Salient events in the geologic history of California. Science N. S. **30:** 346–351. 1909.

[3] Salisbury, R. D. Physical geography of the Pleistocene with reference to the correlation of Pleistocene formations. In Willis & Salisbury, Outlines of Geologic History. 306 pp. 1910.

[4] Osborn, H. F. The age of mammals. 635 pp. 1910.

[5] Salisbury, R. D. *l. c.*

[6] Smith, J. P. *l. c.*

[7] Russell, I. C. Geological history of Lake Lahontan. U. S. Geol. Surv. Monogr. **11:** 1–288. 1885.

[8] Gilbert, G. K. Lake Bonneville. U. S. Geol. Surv. Monogr. **1:** 1–438. 1890.

TABLE I

A CHART SHOWING RESULTS OBTAINED BY APPLICATION OF CRITERIA TO DETERMINE A CENTER OF DISTRIBUTION

Criterion	Section I	Section II	Section III	Section IV
	Unit: subspecies	Unit: species	Unit: species	Unit: subspecies
1. Greatest number of units	Palomar-Santa Rosa Cuyamaca	San Gabriel-San Bernardino	S. W. California	San Gabriel-San Bernardino
2. Most diverse units	Palomar-Santa Rosa Cuyamaca (*M. macrantha Hallii* and *M. macrantha arida*)	Bay region (*M. Douglasii* and *M. leucocephala*)	S. W. California (*M. cinerea* and *M. hypoleuca*)	San Gabriel-San Bernardino
3. Focus of geographical avenues of dispersal	Not determined	San Gabriel	Not determined	San Gabriel
4. Center of dispersal of unit least modified.	Cuyamaca region (*M. macrantha eumacrantha*)	? San Gabriel (*M. lanceolata*)	Bay region (*M. villosa euvillosa*)	Not determined
5. Most units most successful: a. vegetative vigor b. reproductive vigor c. least restricted habitat	a. Palomar-Santa Rosa Cuyamaca b. Not determined c. Not determined	a. San Gabriel-San Bernardino b. Not determined c. Not determined	a. S. W. California b. Not determined c. Not determined	a. ? Mt. Shasta b. Not determined c. Not determined
6. Center of dispersal of nearest ally		As indicated in the above columns		
7. Center of evolutional tendencies	Palomar-Santa Rosa Cuyamaca		Not determined	Not determined

called Ice Age, was of long duration and is thought to have been divided into several warmer inter-glacial epochs. At the beginning of the Pleistocene the flora and fauna of this region were essentially of a temperate type and included many surviving forms. At the period of maximum glaciation, however, the biota was reduced both in number and in kinds.[1] If the remains produced by the Conard Fissure are correctly placed in point of time, they would indicate that the climate of Arkansas at that time was much the same as British Columbia at present, with an analagous fauna.[2] The larch extended as far south as Georgia.[3] The climate of California at that time has been compared to the present climate of the Olympic Peninsula, cool and rainy, and productive of heavy forests.[4] To the east of the ice-covered Sierra and Cascade ranges lay a vast upland correspondingly elevated, with a higher rainfall than at present, and characterized by the great inland lakes Lahontan and Bonneville which were fed from the rivers and glaciers of the Sierra Nevada and Cascade Ranges and Wasatch Range.[5] The musk-ox ranged as far south as Salt Lake City, indicating in the north a tundra-like region.[6]

There is, then, fairly certain evidence of the repeated displacements of the existing biota during the Pleistocene and a consequent actual southward migration of both plants and animals together with the reappearance of the survivors as the climate ameliorated.

As at present constituted *Monardella* is an inhabitant either of semi-arid or arid situations in the transition zone, or of the chaparral. From a study of the apparent evolutionary tendencies it has been suggested that the genus represents a group of plants of mesophytic origin which has become more and more adapted to such a habitat. It does not seem probable that the genus maintained its present range during the Pleistocene. It is obvious that most of its present range east of the great valley of California would have been uninhabitable by reason of the boreal

[1] Osborn, H. F. The age of mammals, p. 500. 1910.

[2] Osborn, H. F. *l. c.* pp. 487–488.

[3] Osborn, H. F. *l. c.*, pp. 449.

[4] Smith, J. P. Salient events in the geologic history of California. Science N. S. **30**: 346–351. 1909.

[5] Gilbert, G. K. Lake Bonneville. U. S. Geol. Surv. Monogr. **1**: 1–438. 1890.

[6] Osborn, H. F. *l. c.* p. 485.

or sub-boreal nature of the stations. While the genus may have existed at lower levels on the great plateau, the facts of present distribution suggest rather that it has entered this area since the glacial period. Nor does it seem probable that the present range in California was maintained, in view of the fact that the genus is at present rarely found even in the outskirts of the northwestern hygrophytic forests which presumably extended much further south during the Pleistocene. One is led consequently to the conclusion that *Monardella* or its precursors migrated southward at this time. Such a conclusion is supported by other facts of present distribution.

There is evidence to suggest that, at the time of maximum elevation during the Pleistocene, the Channel Islands off the coast of southern California (? Lower California also) were continuous with the present mainland and evidently supported a similar biota. With the subsequent depression the connecting valleys were flooded and eventually only the highest points which constitute the present islands were left uncovered. The present flora of these islands,[1] while essentially that of the present mainland, nevertheless contains at least one genus no longer found upon the mainland and numerous endemic species as well, suggesting very strongly the preservation of certain types through isolation.

Monardella has been reported from these islands twice, namely, from Santa Catalina Island and from Cedros Island. *M. lanceolata* was reported from Santa Catalina Island by Lyon. The author has seen no material supporting this report nor was Millspaugh[2] able to verify it after examination of Lyon's collection. If seen by Lyon it is not improbable that the plant was a recent adventive. The only species definitely known to grow on any of these islands is *M. thymifolia* Greene, endemic on Cedros

[1] Watson, S. On the flora of Guadalupe Island, Lower California. Proc. Am. Acad. **11**: 105–121. 1876; Lyon, W. L. The flora of our southwestern archipelago. Bot. Gaz. **11**: 197–205, 330–336. 1886; Greene, E. L. Botanical excursion to the island of San Miguel. Pittonia **1**: 74–93. 1887; Botany of Cedros Island. *Ibid.* 194–208. 1888; Supplementary list of Cedros Island plants. *Ibid.* 266–269. 1889; Vegetation of San Benito Islands. *Ibid.* 261–266. 1889.

[2] Millspaugh, C. F., and Nuttall, L. W. Flora of Santa Catalina Island. Field Mus. Nat. Hist. Publ. 212. 1923.

Island. Since *M. thymifolia* is most nearly allied to *M. villosa*, yet separated from it by perhaps 750 miles, occurring as it does at the southernmost extreme of the generic range, it may be inferred that the common stock from which both have originated had a much more southerly range than *M. villosa* now occupies. Furthermore, the fact that *M. macrantha* subsp. *eumacrantha* occurs in an isolated montane community as far south as San Pedro Martir in Lower California suggests a former wider and more southerly range for that species. *M. linoides* presents a similar case.

From the inferences drawn in the preceding paragraphs we may arrive at the following explanation of the present distribution of the genus. The precursors of *Monardella* were pushed southward during the glacial period of the Pleistocene. The surviving representatives again migrated northward when conditions of climate were ameliorated. The prototypes of each of the sections previously discussed became established approximately in the present centers of dispersal of each group and were variably successful in maintaining themselves and increasing their range. With increasing aridity of the climate among other factors, and due in part to isolation, the present species have arisen, and of these the most widespread and thus, perhaps, the most successful, is *M. odoratissima*.

MONARDELLA Benth.

Monardella Benth. Lab. Gen. & Sp. 331. 1834; in DC. Prodr. **12:** 190. 1848; Benth. & Hook. f. Gen. Pl. **2:** 1185. 1876; Gray, Proc. Am. Acad. **11:** 100. 1876; Bot. Calif. **1:** 593. 1876; Syn. Fl. N. Am., ed. 2, **2**[1]**:** 356. 1886; Briq. in Engl. & Prantl, Nat. Pflanzenf. IV. Abt. 3a, 309. 1896; Howell, Fl. Northwest Am. 549. 1901; Nelson in Coulter & Nelson, Man. Cent. Rocky Mts. 430. 1909; Jepson, Fl. West. Middle Calif., ed. 2, 363. 1911; Abrams, Muhlenbergia **8:** 26. 1912; Fl. Los Angeles, ed. 2, 317. 1917; Davidson & Moxley, Fl. South. Calif. 312. 1923.

Madronella Greene, Leaflets Bot. Obs. **1:** 168. 1906; Piper, Contr. U. S. Nat. Herb. **9:** 493. 1906; Frye & Rigg, Elem. Fl. Northwest, 195. 1914; Piper & Beattie, Fl. Southeast. Washington, 216. 1914; Fl. Northwest Coast, 309. 1915; Rydberg, Fl. Rocky Mts., ed. 2, 750. 1923.

Annual or perennial herbs, of fragrant odor, with small entire or serrate leaves, flowers borne in terminal, globose, bracteate glomerules. Calyx tubular, narrow, 10–15-nerved, 5-dentate; teeth triangular, subequal, erect; throat naked. Corolla small, usually rose-purple, sub-bilabiate, the upper lip two-lobed, the lower lip three-lobed, the lips subequal, plane, the lobes linear-oblong. Stamens four, all fertile, the anterior pair exceeding the posterior, or subequal, erect, distinct, not greatly exserted. Anthers bilocular, the locules oval, subparallel to divaricate, subconfluent above but distinct. Style shortly and unequally bifid at the summit. Ovary four-parted, the nutlets oblong-oval, smooth, brown at maturity.

The type species is *Monardella odoratissima* Benth.

Key to the Subgenera[1]

A. Limb of corolla ½–$^1/_5$ the length of the tube; calyces 10–25 mm. long . . . . MACRANTHAE

B. Limb of corolla ½–⅔ the length of the tube; calyces 5–10 mm. long . . PYCNANTHAE

Subgenus 1. MACRANTHAE Briq. in Engl. & Prantl, Nat. Pflanzenfam. IV. Abt. 3a, 309. 1896 (adapted from Gray, Proc. Am. Acad. **11**: 100. 1876); Abrams, Muhlenbergia **8**: 26. 1912.

Stem slender, rhizomatous, the branches decumbent or ascending; glomerules loosely flowered, usually with less than 20 flowers, bracts oblong; calyx 10–30 mm. long, slender, 13-nerved;

[1] The abbreviations used herein are as follows:
BH—Baker Herbarium of Pomona College.
CAS—California Academy of Science.
CSM—Colorado State Museum, Denver.
DH—Dudley Herbarium of Leland Stanford University.
FM—Field Museum of Natural History, Chicago.
GH—Gray Herbarium of Harvard University.
J—Herbarium of W. L. Jepson.
KH—Kew Herbarium.
MBG—Herbarium of the Missouri Botanical Garden, St. Louis.
NYS—Herbarium of the New York State Museum.
OAC—Oregon Agricultural College Herbarium, Corvallis.
RMH—Rocky Mountain Herbarium, University of Wyoming.
S—Herbarium of H. St. John.
UC—Herbarium of the University of California.
US—U. S. National Herbarium at Washington.

corolla red, yellowish or pallid, the limb $^1/_2$ to $^1/_5$ the length of the tube.[1]

§ Section I—Macranthae

Key to the Species

A. Corolla 20–45 mm. long; leaves generally pubescent........*1. M. macrantha*
B. Corolla 15–18 mm. long; leaves glabrate on both surfaces......*2. M. Palmeri*

1. **M. macrantha** Gray, Syn. Fl. N. Am. ed. 2, 2[1]: 459 (suppl.). 1886. Hall, Univ. Calif. Publ. Bot. **1**: 110. 1902.

Perennial from slender rhizomatous stems, the branches decumbent or ascending, 10–30 cm. long, seldom branching, pubescent with short recurved trichomes, or villous, purplish; leaves subcoriaceous, variable on the same plant, the blades .5–3 cm. long, ovate to lanceolate, subcuneate at the base and generally broadest about one-quarter their length from the base, very obtuse, entire or obscurely crenate-serrate, glabrous to villous or cinereous on petioles .5–1.5 cm. long; glomerules *2–4 cm. broad*, bracts oblong-elliptical, approximately equal to the calyces, acute, membranous, purplish or whitish, sparsely villous, ciliate; calyx variable in size on the same plant, *1.2–2.5 cm. long*, purplish or green, sparsely villous, teeth acute, slender, villous within; corolla *scarlet to yellowish* or pallid, puberulent, the tube greatly exserted, the limb 5–11 mm. long, the upper lip the longer, the lobes coalesced more than half the length of the lip, those of the lower lip nearly free; the anther 1–1.5 mm. wide, the sacs widely divergent, the connective wider than the length of the sac, the margin retuse.

Key to the Subspecies

Corolla for the most part 35–45 mm. long; calyx 20–25 mm. long.. subsp. *eumacrantha*
Corolla for the most part 25–30 mm. long; calyx 12–15 mm. long.. subsp. *nana*

[1] All measurements of flower parts herein given are based upon flowers which were fresh and in full bloom when pressed and which were boiled in water prior to study. It should be observed that flower parts which have withered naturally before pressing never regain their full size but remain much shrunken. If the flower to be examined be dissected upon a microscope slide mounted in a drop of thin mucilage, it may be preserved indefinitely without shrinkage by allowing the mucilage to dry. On addition of a drop of warm water it may again be examined.

a. Subsp. **eumacrantha,** nom. nov.

Monardella macrantha Gray, Proc. Am. Acad. **11:** 100. 1876; Bot. Calif. **1:** 593. 1876, **2:** 476. 1880; Syn. Fl. N. Am., ed. 2, **2**[1]: 356. 1886; Abrams, Muhlenbergia **8:** 28. 1912; Davidson and Moxley, Fl. South. Calif. 313. 1923.

Madronella macrantha Greene, Leaflets Bot. Obs. **1:** 169. 1906.

Blades of the leaves *1–3 cm. long,* glabrate above and pubescent beneath, rarely pubescent on both surfaces (villous in the variety); glomerules 3–4 cm. broad, *bracts seldom equaling the calyces, purple;* calyx in general *20–25 mm. long;* corolla scarlet or yellowish, in general 30–45 mm. long, the anthers 1.25–1.5 mm. wide.

Specimens examined:

CALIFORNIA: Big Sur, May–June, 1901, *Davy 7436* (UC); Santa Lucia Mts., June 10, 1909, *Brandegee* (UC); Cuyamaca Mts., July 12, 1875, *E. Palmer 295* (GH, TYPE; MBG); Cuyamaca Mts., Sept. 1882, *Orcutt 485* (GH); San Diego Co., *Orcutt* (MBG); Santa Lucia Mts., 1885, *Brandegee* (GH); Tassajara Hot Springs, Monterey Co., June 1901, *Elmer 3228* (MBG; US); Laguna Mts., June 28, 1919, *Eastwood 9227* (GH); Smith Mt., San Diego Co., July 25, 1882, *Orcutt* (MBG); between Cuyamaca and Julian, June 21, 1903, *Abrams 3812* (US; MBG; GH) Julian City July 15, 1875, *Cleveland* (GH); Cuyamaca Peak, 5000 ft., June 30, 1897, *Reed* (BH); Cuyamaca Lake, dry stony slopes, 4700 ft., June 27, 1923, *Munz & Harwood 7241* (BH); Laguna Mts., July, 1889, *Orcutt* (US); Santa Lucia Mts., 1880, *G. R. Vasey 487* (US); Cuyamaca Mts., 1875, *E. Palmer 294* (US); Julian, Cleveland Nat. Forest, July 29–30, 1915, *Hitchcock* (US); Pine Hills, July 29, 1915, *Collins & Kempton 268* (US); West Fork Trail near Sturdevant's, San Gabriel Mts., 4250 ft., July 13, 1918, *Peirson 183* (J).

LOWER CALIFORNIA: San Pedro Martir, Aug. 1903, *Robertson 33* (UC, leaves small for the plant and pubescent on both sides); Oallecitos, San Pedro Martir, 8000 ft., July 15, 1905, *Goldman 1228* (US).

Var. **Hallii** Abrams, Muhlenbergia **8:** 29. 1912; Davidson and Moxley, Fl. South. Calif. 313. 1923.

M. macrantha var. *tenuiflora* Hall, Univ. Calif. Publ. Bot. **1:** 110. *pl. 11.* 1902 (neither of Watson nor Gray).

M. macrantha var. *longiloba* Abrams, Muhlenbergia **8**: 29. 1912; Davidson and Moxley, Fl. South. Calif. 313. 1923.

Branches and leaves villous, the latter in general 2 cm. long or more and tending to be ovate rather than lanceolate, frequently subtruncate at the base and very obtuse; corolla frequently yellowish, *the limb being sometimes as long as 10–11 mm., the lobes being correspondingly slender and very acute*.

Specimens examined:

CALIFORNIA: Smith Mt., San Diego Co., July 19, 1890, *I. J. Gray* (MBG); chaparral belt of south side, canyon of the San Jacinto R., 4300 ft., July 4, 1898, *Hall 976* (UC, TYPE of var. *longiloba* Abrams; US; fragment GH); San Jacinto Mts., 4000 ft., July 16, 1897, *Hall 687* (UC); chaparral belt, San Jacinto River, 4400 ft., June 19, 1897, *Hall 669* (UC); Mill Creek, San Bernardino Co., July 8, 1898, *Parish 4578* (US); San Bernardino Co., 1876, *Parry & Lemmon 328* (GH; MBG); Palomar, May, 1901, *Hall 1936* (MBG; US; *type collection*, TYPE in Dudley Herb.); City Creek Road, San Bernardino Mts., 5000 ft., July 17, 1921, *Johnston 2858* (BH).

b. Subsp. **nana** (Gray), comb. nov.

Monardella nana Gray, Proc. Am. Acad. **11**: 101. 1876; Bot. Calif. **1**: 593. 1876; Syn. Fl. N. Am., ed. 2, 2^1: 356. 1886; Abrams, Muhlenbergia **8**: 30. 1912; Davidson & Moxley, Fl. South. Calif. 313. 1923.

M. macrantha var. *nana* Gray, Syn. Fl. N. Am. ed. 2, 2^1: 459 (suppl.). 1886; Hall, Univ. Calif. Publ. Bot. **1**: 111. 1902.

M. villosa var. *leptosiphon* Torrey, Bot. Mex. Bound. 129. 1859 (*not* Gray, Bot. Calif. **1**: 593. 1876; Syn. Fl. N. Am., ed. 2, 2^1: 357. 1886).

M. nana var. *leptosiphon* Abrams, Muhlenbergia **8**: 31. 1912; Davidson and Moxley, Fl. South. Calif. 313. 1923.

Madronella nana Greene, Leaflets Bot. Obs. **1**: 169. 1906.

Blades of the leaves in general *.5–1.5 cm. long*, less commonly 2 cm. long, ovate rather than lanceolate with a tendency to become truncate at the base, glabrous on the upper surface and pubescent beneath or sparsely villous or cinereous throughout; glomerules 2–3.5 cm. broad, *bracts usually somewhat longer than* *the calyces and often whitish;* calyx in general *12–16 mm. long,* corolla pinkish or pallid, in general 20–35 mm. long, the anthers 1 mm. wide.

Specimens examined:

CALIFORNIA: Cuyamaca Mts., 4500 ft., May 29, 1899, *Hall 1202* (UC); mountains in back of San Diego, 1875, *Cleveland* (GH; TYPE); San Felipe, 1881, *Cleveland 770* (GH); between Cuyamaca and Oriflamme Canyon, San Diego Co., June 28, 1903, *Abrams 3941* (GH; MBG; BH; US); Laguna Mts., San Diego Co., June 28, 1919, *Eastwood 9215* (US; GH); Laguna Mts., San Diego Co., July, 1889, *Orcutt* (MBG; US); Laguna Mts., 5700 ft., June 2, 1920, *Spencer 1560* (BH); Laguna, June 14, 1894, *Schoenefeld 3544* (US); Julian, 1880, *Vasey* (US); Smith Mt., San Diego Co., July, 1882, *Orcutt* (GH); Julian, San Diego Co., June 13, 1894, *Brandegee* (UC); Smith Mt., July 15, 1890, *Orcutt 2110* (US).

LOWER CALIFORNIA: mountains of Lower California (near Japa), July 5, 1884, *Orcutt* (FM).

Var. **tenuiflora** Gray, Syn. Fl. N. Am., ed. 2, **2**[1]: 459. 1886 (suppl.); not of Hall, Univ. Calif. Publ. Bot. **1:** 110. *pl. 12.* 1902.

Monardella tenuiflora Watson in Gray, Proc. Am. Acad. **17:** 230. 1882.

M. nana var. *tenuiflora* Abrams, Muhlenbergia **8:** 32. 1912; Davidson & Moxley, Fl. South. Calif. 313. 1923.

M. macrantha var. *pinetorum* Hall, Univ. Calif. Publ. Bot. **1:** 110. *pl. 12.* 1902.

Branches 10–15 mm. tall, *short-pubescent;* leaves *cinereous-pubescent,* the trichomes usually appressed but frequently somewhat villous, blades averaging 1 cm., the petioles 4–5 mm.; corolla pale yellow to almost white; the *tube averaging 20 mm.,* barely tapering, the limb *6–8 mm.* long, the *lobes acute, narrower at the base than towards the middle,* somewhat exceeding the stamens.

Specimens examined:

CALIFORNIA: Santa Rosa Mts., frequent in partly shady rocky slopes in the chaparral belt, 5700 ft., June 26, 1922, *Munz 5833* (BH); between Tahquitz and Round Valley, San Jacinto Mts., 7500 ft., July 6, 1922, *Munz 6033* (BH); San Jacinto Mts., 6000–

8000 ft., July 17, 1897, *Hall 691* (UC; fragment in GH); San Jacinto Mts., Aug. 1881, *S. B. & W. F. Parish 327* (UC); San Jacinto Mts., July, 1880, *S. B. & W. F. Parish 327* (GH, TYPE; MBG; US); San Jacinto Mts., 8500 ft., July 2, 1895, *A. W. Anthony* (UC); Fuller's Mills Mts., San Jacinto Range, 6500 ft., July, 1901, *Hall 2559* (UC, this and the following approach subsp. *eumacrantha* var. *Hallii* in the structure of the corolla but retain the small anther; in size of corolla they are very similar to Elmer's collection of *M. macrantha* at Tassajara); pine-clad slopes of west side (San Jacinto Canyon), 6000 ft., June 24, 1901, *Hall 2258* (UC); Tahquitz Valley, San Jacinto Mts., July 22, 1897, *Hall 725* (UC, 25479, TYPE of *M. macrantha* var. *pinetorum* Hall; US); San Jacinto Mt., halfway between forks of Summit Trail and Log Cabin on upper trail, 8000 ft., no date, *Jepson 2322* (J); Palm Canyon and return to Van Deventer's, May 17–June 1, 1901, *Jepson & Hall 1336* (J).

LOWER CALIFORNIA: Japa, 9000 ft., July 5, 1884, *Orcutt* (GH).

Var. **arida** Hall, Univ. Calif. Publ. Bot. **1**: 111, *pl. 10*. 1902.

M. nana var. *arida* Abrams, Muhlenbergia **8**: 33. 1912; Davidson & Moxley, Fl. South. Calif. 313. 1923.

Low, branches less than 10 cm. long, *cinereous; leaves cinereous,* the blades 0.5–1.0 cm. long, the petioles often longer, averaging about three-fourths the length of the blade; corolla pale yellow to almost white; the *tube less than 18 mm.* long, scarcely tapering, *less than a millimeter wide,* the limb *4–6 mm.* long, *the lobes oblong* rather than tapering, often obtuse, exceeding the stamens slightly.

Specimens examined:

CALIFORNIA: desert region to the southeast of San Jacinto Mt., along Coyote Creek at 5000 ft., June, 1901, *Hall 2127* (UC 25475; MBG; US); Coyote Canyon, Santa Rosa Mt., 5000 ft., May, 1899, *Hall 1180* (UC; RMH; US); between Vandeventer's and Palm Canyon, San Jacinto Mts., 4000 ft., May, 1901, *Hall 1852* (UC); Old Nicholas Canyon, Santa Rosa Mts., common in dry clearings in chaparral, 5000 ft., July 1, 1922, *Munz 5936* (BH).

M. macrantha was based originally upon the collections of both Cleveland and Palmer, the first collected at "Julian City," the second in the "Cuyamaca Mts." In a note at the end of the original description Gray interchanged the order of the collectors' names and the localities from whence the collections were made and wrote "Southern part of California in the Cuyamaca Mountains and near Julian City, D. Cleveland, E. Palmer." Both collections at the Gray Herbarium are mounted upon the same sheet and are similar although the former is scant. It is evident that the original description is drawn mainly from the Palmer collection and since, of the two, it only is labeled in Gray's hand "*Monardella macrantha* n. sp." and is more copiously represented, it is here considered the historical type.

In the same paper in which *M. macrantha* was published, *M. nana* was described and united with it to form a generic section. *M. nana* was based upon a collection by Cleveland in the same year and same locality. The two species thus constituted were published again in the 'Botany of California' and in the 'Synoptical Flora.' In the supplement to the second edition of the latter, however, *M. nana* was made a variety of *M. macrantha*, together with *M. tenuiflora* Wats. published in 1882. This interpretation was accepted by Hall, who studied the plants in the field and described two varieties as new, referring certain plants to *M. macrantha* var. *tenuiflora* (Wats.) Gray. One of the newly described varieties was *M. macrantha* var. *pinetorum*. A comparison of the plants referred to var. *tenuiflora* with the type specimen indicated to Abrams that this variety had been misinterpreted by Hall and that *M. macrantha* var. *pinetorum* Hall was in fact *M. macrantha* var. *tenuiflora* Gray. Abrams therefore applied the name *M. macrantha* var. *longiloba* to the plants referred by Hall to *M. macrantha* var. *tenuiflora*, and named the plants referred by Hall to *M. macrantha* (not the variety) var. *Hallii*, since they did differ from the type of *M. macrantha* in the villosity of the foliage.

The chief character upon which var. *longiloba* was based lay in the unusually long (10 mm. or more) lobes of the corolla which were correspondingly slender and acute. The chief character upon which var. *Hallii* was based lay in the abundant villosity of the foliage. The present author agrees with Abrams that *M. macrantha* var. *tenuiflora* Hall is not synonymous with *M. macrantha* var. *tenuiflora* Gray. A careful study of the group, however, has not demonstrated that var. *longiloba* and var. *Hallii* may be segregated by any constant group of characters.

M. macrantha varies tremendously, and yet, as stated by Hall, all gradations between the extremes may be found nor do any very constant lines of cleavage appear to exist. The combinations of characters which appear are very puzzling. The clearest hiatus appears between those groups herein described as subspecies. Subsp. *eumacrantha,* on the one hand, is made up of plants which are more or less lax in their habit, trailing, with leaves which are comparatively large, being 2–3 cm. long, and with flowers unusually large for the genus, being in general 30–45 mm. long and scarlet or yellowish. Subsp. *nana,* on the other hand, has a more compact growth form, particularly in the plants of more arid habitat, with smaller leaves and flowers which are pinkish or yellowish-white and in size from 20 to 35 mm. long. The pubescence of this group is more often dense and close, giving a cinereous aspect to the plant.

In the first subspecies, while the range of variation is considerable, there does not seem to be any very definite occurrence of concomitant characters save that, in general, plants with the larger ovate villous leaves also have the elongated lobes of the corolla. Such plants have accordingly been referred to var. *Hallii,* and since the occurrence of the elongate lobes is more or less connected with the villous leaves, var. *longiloba* is considered synonymous with it. All gradations exist.

In the second subspecies two variants from the more typical plant may be more clearly discerned and appear to have a distribution which is characteristic. The subspecies proper has foliage which in general resembles that of subsp. *eumacrantha* and like it varies from pubescent to villous, but is in general smaller, ranging from 1 to 2 cm. in length. The pubescence, however, is closer and more cinereous. The corolla is smaller, and presents one or two qualitative differences as well, namely, in the shape of the tube, which is evenly tubular and less funnel-form, and in the shape of the lobes, which are more slender and usually slightly narrower at the base and longer in proportion to the length of the tube. The anthers are distinctly smaller, averaging 1 mm. in width. These differences were noted by Abrams and used as a means to segregate *M. nana.* Nevertheless, they are not constant, the form described by Torrey as *M. villosa* var. *leptosiphon* clearly connecting the two subspecies.

The variety *tenuiflora* (var. *pinetorum* Hall) has smaller leaves (1 cm.), which are distinctly cinereous on both surfaces with a corolla much exserted, the limb being 6–8 mm. long, the lobes very acute. The petioles of the leaves are somewhat less than half the length of the blade. The variety *arida* has similar foliage but smaller, the blades being .5–1 cm. long and the petioles often three-fourths the length of the blade. The growth form is very compact. The corolla is much less exserted, the limb being 4–6 mm. long, the lobes oblong-linear and rather blunt. All gradations occur.

It is impossible from present knowledge of the group to judge to what extent these forms represent racial differences and to what extent they represent forms induced by the environment. To determine this will require careful field study and experiment.

The present author has not seen the type of *M. villosa* var. *leptosiphon* which was based upon a collection by Parry at "San Felipe," but from the description there can be little doubt as to the plant referred to, particularly so from the description of the corolla and stamens. It was confused by Gray with a subspecies of *M. villosa* common to central California, an error which was perpetuated until attention was directed to it by Abrams, and in the Gray Herbarium there is apparently no authentic material of Torrey's plant.

2. **M. Palmeri** Gray, Proc. Amer. Acad. **12**: 82. 1877; Bot. Calif. **2**: 476. 1880; Syn. Fl. N. Am., ed. 2, **2**[1]: 357. 1886.

Madronella Palmeri Greene, Leaflets Bot. Obs. **1**: 169. 1906.

Perennial from a slender, rhizomatous stem, the branches low, ascending, 10–15 cm. long, purplish, *scarcely puberulent;* leaves subcoriaceous, 1–2 cm. long, *oblong or lanceolate-oblong,* entire or nearly so, obtuse, glabrous, the midvein hardly perceptible, tapering into a very short petiole or sessile; glomerules large in proportion, 2.5–3 cm. broad, purplish, bracts exceeding the calyces, oblong, the innermost linear-oblong, obtuse, thin and membranous, reddish purple, puberulent; calyx 9–11 mm. long, reddish purple, 13-veined, rather definitely bilabiate, the teeth slender, 1.5–2 mm. long, hirsute within; corolla 15–17 mm. long, the tube slender, twice the length of the limb, retrorsely hirsute in the throat, the limb 5–6 mm. long, the lips about equal, the lobes of the upper lips coalesced about one-half its length, those of the lower lip approximately free, tapering slightly; stamens about equal, the anthers less than 1 mm. wide, the anther-sacs divaricate, the angle about 90°, the margin of the connective apparently entire, or if retuse, very slightly; nutlets 2.5 mm. long.

Specimens examined:

California: Santa Lucia Mts., under the redwoods, Aug. 2, 1876, *E. Palmer 359* (GH, type; MBG; US); no locality given, *Brandegee* (GH); Santa Lucia Mts., July, 1880, *Vasey 498* (US; FM).

Subgenus 2. Pycnanthae Briq. in Engler & Prantl, Nat. Pflanzenf. IV. Abt. 3a, 309. 1906 (adapted from Gray, Proc. Am. Acad. **11**: 101. 1876); Abrams, Muhlenbergia **8**: 26. 1912.

Stems various, decumbent or erect but not rhizomatous; glomerules compactly flowered, usually with thirty or more flowers; bracts variable, tending to ovate or lanceolate; calyx 5–10 mm. long, 10–15-nerved; corolla rose-purple or pallid, the limb one-half to two-thirds the length of the tube.

Key to the Species

A. Annuals; stem herbaceous and not suffrutescent.
- a. Bracts fenestrate, i.e., the intravenous tissue like isinglass . . . . *13. M. Douglasii*
- b. Bracts membranous or scarious, but not fenestrate.
  - α Margin of the calyx teeth white-scarious or terminating in a white, recurved cusp.
    - 1. Teeth ending in a white recurved cusp. . . . *19. M. leucocephala*
    - 2. Teeth blunt, margin white-scarious.
      - I. Lower margin of connective entire; calyx 15-nerved. . . . . *18. M. exilis*
      - II. Lower margin of connective distinctly notched; calyx 13-nerved . . . . . *17. M. candicans*
  - β. Margin of the calyx teeth bounded by a distinct vein, not scarious.
    - 1. Leaves plane, lanceolate or oblong.
      - I. Bracts puberulent.
        - *Bracts acuminate, secondary veins absent or not prominent . . . . *15. M. Breweri*

**Bracts acute, secondary veins green, net-like, prominent. . . . . *14.* *M. lanceolata*
II. Bracts villous throughout. . . . . *16.* *M. Pringlei*
2. Leaves undulate or crisped, oblanceolate-oblong. . . . . *12.* *M. undulata*

B. Perennials; stem woody at the base and suffrutescent.
a. Leaves oblanceolate-oblong, undulate or crisped. *12.* *M. undulata*
b. Leaves ovate to linear, plane.
α. Bracts reflexed, foliar in texture and shape. *4.* *M. villosa*
β. Bracts erect, sheathing, firm or membranous, but only the outer pair foliar (see also *M. villosa* subsp. *neglecta*).
1. Leaves with a strongly developed felt-like tomentum on the under surface, glabrous or lanate above.
I. Leaves glabrous above.. . . . . *5.* *M. hypoleuca*
II. Leaves lanate above . . . . *6.* *M. lanata*
2. Leaves pubescent or glabrous, often paler beneath, but never felt-like.
I. Leaves .5–.8 mm. long, more or less crenate-dentate.
*Plant short pubescent, cinereous, not villous. . . . . *3.* *M. thymifolia*
**Plant short-villous, hoary with a bluish cast. *9.* *M. cinerea*
II. Leaves 1–several cm. long, mostly entire.
*Foliage and stem silvery white, with a dense microscopic puberulence; leaves typically linear-oblong. . . . . *11.* *M. linoides*
**Foliage and stem glaucous-like in some but not silvery white; leaves typically lanceolate.
†Bracts firm, neither membranous nor chaffy; lobes of corolla blunt.
‡Leaves glabrous above, 2–5 mm. long. . . . . *8.* *M. saxicola*
‡‡Leaves pubescent on both surfaces, seldom 2 cm. long . . . . *7.* *M. viridis*
††Bracts membranous, often reddish-purple; lobes of corolla rounded to a point. . . . . *10.* *M. odoratissima*

§ Section II. Villosae

3. M. thymifolia Greene, Bull. Calif. Acad. Sci. **1:** 211. 1886; Gray, Syn. Fl. N. Am., ed. 2, **2**[1]**:** 459. 1886.

Madronella thymifolia Greene, Leaflets Bot. Obs. **1:** 169. 1906.

Perennial, shrubby, 12–20 cm. tall, *much branched, the lower branches woody*, covered with a grayish brown checking bark, spreading, the upper branches erect, slender, pubescent; leaves 5–8 mm. long, ovate triangular, very obtuse, margin recurved, entire or obscurely serrate, soft-pubescent, petioles broad, 1–2 mm. long; *glomerules a centimeter or less in diameter*, bracts ovate, acute, equaling the calyces, herbaceous (Greene), *becoming chaffy and brittle*, pinnately veined, thinly pubescent, the margin subciliate; calyx 6–7 mm. long, thinly pubescent; corolla purplish (Greene), 12–13 mm. long, the tube about 8 mm. long, the lips subequal; the lobes of the upper lip coalesced about two-thirds its length, those of the lower lip about one-fourth its length, tapering but little, obtuse, anther-sacs divergent, the connective equilateral, well developed, nutlets oblong-oval, 1.5 mm. long.

Specimens examined:

Lower California: Cedros Island, 1859, *Veatch* (UC; GH); Cedros Island, July–Oct. 1896, *A. W. Anthony 143* (US; GH); Cedros Island, March–June, 1897, *Anthony 316* (GH; MBG; US); Cedros Island, March 22, 1911, *Rose 16162* (US).

The few specimens which are available for study are uniform in appearance, but are for the most part past flower, the glomerules being dry and chaffy and straw-colored. The bracts are stated by Greene to be herbaceous. The only specimen examined in which this point might be determined (US 313872) showed the outer pair erect and subfoliaceous only, the inner being membranous but firm, the veins being well developed. All were tinged with rose and were noticeably pubescent and glandular.

4. M. villosa Benth. Bot. Voy. Sulph. 42. *pl. 21.* 1844; in DC. Prodr. **12:** 190. 1848; Gray, Proc. Am. Acad. **11:** 101. 1876; Bot. Calif. **1:** 593. 1876, excl. variety; Syn. Fl. N. Am., ed. 2, **2**[1]**:** 357. 1886, excl. variety; Jepson, Fl. West. Middle Calif., ed. 2, 364. 1911.

Perennial from decumbent stems, woody at the base, the bark brown in old stems, often checking; the branches erect, simple, or often with short, usually sterile secondary branchlets; of variable stature, 10–60 cm. tall, variably pubescent near the inflorescence, glabrate below; leaves exceedingly variable, *in general ovate*, varying, on one hand, to rotund and, on the other, to lanceolate, obtuse, *obscurely crenate-serrate*, or entire, or coarsely dentate-serrate, usually of a firm texture, *villous or villous-tomentose* to glabrate, blades 1–3 cm. long, rounded at the base, but abruptly tapering into a petiole 0.5–1.0 cm. long; glomerules compact, 2–4 cm. broad, *bracts leaf-like in shape and texture*, only the innermost sometimes membranous, about equal to the calyces, *reflexed*, villous or tomentose, conforming to the pubescence of the plant; calyx 7–10 mm. long, 13-nerved, scarious below, green and *shaggy-villous above*, teeth ovate-triangular, villous without and on the margins; corolla 10–18 mm. long, rose-purple to pallid, the *lobes linear-oblong and ribbon-like*, blunt, those of the upper lip coalesced usually about half its length, those of the lower lip nearly or wholly free; stamens about the length of the lobes, the filaments retrorsely hispidulous near the base, the anther sacs divergent, the connective equilateral, well developed.

The following classification represents an attempt to characterize what appear to be the principal tendencies of evolution within *M. villosa*. In each subdivision of its range may be found a form which is characteristic of that locality, and while forms geographically distant may be quite diverse all intermediate forms may be found and, taken as a whole, show a close correlation between form and geographical position. This is true to the extent that, after familiarity with the species and its distribution as a whole has been attained, it is possible to place any given plant within a comparatively short distance of its habitat merely by inspection. There are not hard-and-fast lines between these areas of distribution just as there may not be found any constant morphological differences between the forms that inhabit them. Yet taken in their typical aspect, as represented by the modal points in the curve of their variability, it will be found that each subspecies occupies a fairly distinct territory, certainly of a degree of distinctness to be very suggestive. The subsp. *euvillosa*, characterized by leaves which are rather large, thinnish, ovate, sharply serrate and villous, is found along the coast from the Santa Lucia range northward to Mendocino County, the variety *fransiscana* being evidently a form of the littoral. The next and most nearly allied subspecies with which it intergrades imperceptibly is subsp. *subserrata*. This subspecies is characterized by a usually smaller lanceolate leaf which is typically lanceolate and is shallowly serrate. The pubescence is villous but much finer, being frequently subtomentose. Subsp. *subserrata* is found in the Salinas Valley and ranges northward through the coastal valleys to the Bay region and Napa County and northward to Mendocino County. It occurs occasionally in the Sierra Nevada, and in southern Oregon but at low elevations.

Subsp. *Sheltoni*, characterized by a lanceolate, even narrower leaf, which is nearly or quite entire and is glabrate, or puberulent at most, is found chiefly in the Sierra Nevada at elevations as high as 7300 feet and in the Siskiyou Mountains of northern California and southern Oregon. Transitional forms occur on the valley side of the coast range in Central California.

Subsp. *neglecta* is a very doubtful form which is herein treated as a subspecies for convenience and for the purpose of directing attention toward it. It occurs only in the vicinity of Mt. Tamalpais.

Key to the Subspecies

A. Herbage variously pubescent.
   1. Leaves ovate to roundish, villous and green rather than canescent or cinereous. .subsp. *euvillosa*
   2. Leaves lanceolate, rarely ovate, canescent or cinereous. . . . . .subsp. *subserrata*

B. Herbage puberulent at most.
   1. Bracts leaf-like, not markedly ciliate. . . . . .subsp. *Sheltoni*
   2. Bracts membranous, purple, ciliate. . . . . .subsp. *neglecta*

a. Subsp. **euvillosa**, nom. nov.

Monardella globosa Greene, Pittonia **5**: 32. 1902.

M. involucrata Heller, Muhlenbergia **1**: 35. 1904.

Madronella villosa Greene, Leaflets Bot. Obs. **1**: 168. 1906.

Madronella globosa Greene, Leaflets Bot. Obs. **1**: 169. 1906.

Madronella involucrata Heller, Muhlenbergia **1**: 136. 1906.

Branches villous in the upper nodes, leaves ovate, commonly serrate, the teeth of variable prominence, 1–3 cm. long, for the most part 2–2.5 cm., tending to become truncate at the base, rather than cuneate; corolla 12–15 mm. long, the lobes of the upper lip somewhat less than half its length, those of the lower lip somewhat less than its full length.

Specimens examined:

CALIFORNIA: Berkeley, July 4, 1880, *Engelmann* (MBG); Woodside, San Mateo Co., June 9, 1919, *Wattlier* (GH; US); mountains near Santa Cruz in shaded woods, 186–, *Bolander* (GH); "Potrero, near San Francisco, July 30, 1868," *Kellogg & Harford 775* (GH; MBG); Goat Island (San Francisco Bay), June 8, 1882, *Greene* (FM); foothills west of Los Gatos, June 11, 1904, *Heller 7497* (RMH; MBG; OAC; GH; US; foliage varies exceedingly on different sheets of this collection); San Mateo Co., Aug. 11–12, 1897, *Congdon* (GH); Santa Cruz, June 16, 1903, *Thompson* (MBG); no locality, *Coulter 541* (GH; cited by Bentham); Pine Forest at Pacific Grove, Aug. 16, 1905, *Coleman* (DH); Madrone Springs canyon (? Sonoma Co.), 2000 ft., Aug. 14, 1917, *Abrams* (DH); California Redwood Park, Santa Cruz Co., June 18, 1919, *Shockley* (DH); Crystal Springs, June 30, 1903, *Baker 3353* (GH; MBG); Bay-View Hills, June 13, 1912, *Eastwood 349* (US; GH; MBG); Saratoga, Big Basin Road, June 23, 1915, *Abrams 5273* (DH); Angel Island near San Francisco, *Vasey* (GH); Borax Lake, 1865, *Torrey 403a* (GH); New Almaden, 1865, *Torrey* (GH); Mare Island, June 9, 1874, *Greene 226* (GH); Contra Costa, July, 1903, *Elmer 4658* (MBG; US); Niles, Morrison Canyon, June 20, 1897, *Jepson 59h* (J); Weldon Canyon, Vaca Mts., Solano Co., June 1, 1891, *Jepson 50l* (J); Glen Echo, Santa Cruz Co., June 17, 1896, *Jepson 59g* (J); Ft. Bragg, 1914, *Mathews 169* (J; typical); no locality, *Hartweg 1913* (GH); Monterey, *Haenke* (GH); near San Francisco, 1866, *Kellogg* (US); sandy loam, Pajaro Hills, Monterey Co., June-July, 1899, *Chandler 366* (US); San Leandro, Contra Costa Co., June 21, 1915, *Eastwood 4743* (US); Santa Cruz Mts., July 9, 1913, *Hitchcock 221* (US); N. Berkeley Hills, June 30, 1917, *Walker 605* (US); Santa Clara Co., June 1, 1895, *Dudley 4200* (US); Santa Cruz Mts., July 22, 1882, *Pringle* (US).

Var. **franciscana** (Elmer), comb. nov.

Monardella franciscana Elmer, Bot. Gaz. **41**: 320. 1906.

Madronella franciscana Heller, Muhlenbergia **2**: 244. 1906.

Branches villous to *tomentose* in the upper parts; leaves ovate to *rotund, thickish*, obscurely serrate to entire, truncate at the base, even subcordate, the blades commonly about 2 cm. long, villous above, *tomentose and canescent beneath;* corolla 12–18 mm. long, the lobes tapering somewhat, appearing as though foreshortened, those of the upper lip one-third to one-half its length, those of the lower lip somewhat less than its length, the throat more ample than in subsp. *euvillosa.*

Specimens examined:

California: Santa Lucia Mts., 1885, *T. S. Brandegee* (GH); San Juan, back of Monterey, June 14, 1861, *Brewer 713* (GH; US); no locality given, 1853, *Gibbons* (GH); Pine Mt., near San Simeon Bay, San Luis Obispo Co., July 22, 1876, *E. Palmer 361* (US; MBG); San Mateo, July, 1903, *Elmer 4766* (MBG; UC; US; *type collection* of *M. franciscana* Elmer, type in DH); Santa Lucia Mts., Monterey Co., June, 1898, *Plaskett* (GH; US); San Bruno Hills, near Ocean View, San Francisco Co., June 8, 1906, *Heller 8371* (MBG; GH; US); no locality given, 1876, *E. Palmer 360* (US; suggests *M. hypoleuca*).

b. Subsp. **subserrata** (Greene), comb. nov.

Monardella subserrata Greene, Pittonia **5**: 81. 1902.

M. tomentosa Eastwood, Bull. Torr. Bot. Club **30**: 496. 1903.

M. villosa Howell, Fl. Northwest Am. 549. 1901.

M. villosa var. *leptosiphon* Gray, Syn. Fl. N. Am., ed. 2, **2**^{1}: 357. 1886 (not Torrey).

M. mollis Heller, Muhlenbergia **1**: 35. 1904.

Madronella mollis Heller, Muhlenbergia **1**: 138. 1906.

Madronella gigantea Heller, in herb. (Heller 12395). 1916.

Madronella subserrata Greene, Leaflets Bot. Obs. **1**: 169. 1906.

Stems *villous or at least pubescent* in the upper nodes; leaves *lanceolate*, rarely ovate, commonly 2–2.5 cm. long, entire or shallowly serrate, those in the upper nodes canescent from a *villous-like tomentum, varying to a short pubescence, more dense on the lower surface, the trichomes soft and fine;* corolla 15–18 mm. long, the lobes ribbon-like, scarcely tapering, blunt, those of the upper lip one-half its length or more, those of the lower lip usually equal to it.

Specimens examined:

California: Arroyo del Puerto, Stanislaus Co., June 11, 1862, *Brewer 1253* (GH; US); Laytonville, Aug. 2, 1902, *Eastwood* (CAS; type of *M. tomentosa* Eastwood); dry hills, Carmel R., Monterey Co., June 22, 1921, *S. B. Parish 20043* (GH); near Ladoga, Lake Co., June 8, 1919, *Heller 13241* (MBG; GH; US); Jolon, Monterey Co., Sept. 22, 1894, *Eastwood* (GH; an unusual form); Tuolumne City, 2800 ft., July 19, 1911, *Abrams 4719* (DH; approaches the preceding in the degree of pubescence); Ione, 200–500 ft., June, 1904, *Braunton 1046* (MBG; US); gravelly stream bank west of Proberta, Tehama Co., June 19, 1916, *Heller 12395* (OAC; MBG; GH; US; *type collection* of *M. gigantea* Heller); Sonoma Co., *Samuels 162* (US); Mt. Diablo, near Lake, Contra Costa Co., June 30, 1916, *Abrams 5707* (DH); road between Petrified Forest and Mark West, Sonoma Co., July 4, 1916, *Abrams 5790* (DH); between Knight's Valley and Mark West Springs, June 28, 1902, *Heller 5791* (MBG; GH; US); 3 mi. west of Leesville, Colusa Co., June 6, 1916, *Heller 12355* (GH; US; OAC; MBG); near Arnold's on Outlet Creek, Mendocino Co., July 9, 1916, *Abrams 5925* (DH); Jolon, Monterey Co., 1880, *Vasey 492* (US); Valley of Arroyo Seco, Monterey Co., May 30, 1861, *Brewer 678* (GH; US); Searsville Ridge, Santz Cruz Mts., June 2, 1914, *Abrams 1700* (US); New Idria, San Benito Co., July 24, 1861, *Brewer 798* (US); Ukiah, Mendocino Co., June 20–July 3, 1898, *Chesnut 377* (US); Round Valley (east of Mt. Diablo?), July 25, Aug. 3, 1897, *Chesnut 542* (US); mountains of the upper Sacramento, 1845–7, Fremont's 3rd Expedition (US, 43119; MBG, 114315; GH); Grass Valley, Amador Co., July 10, 1894, *Hansen 439* (US); Big Horse Mt., S. Fork Eel R., July–Aug., 1892, *Jepson 30p* (J); grade to Howell Mt., Napa R. basin, June 26, 1893, *Jepson 50 m* (J); Calistoga, June 3, 1923, *Jepson 9969* (J; *M. villosa* var. *tomentosa* Jepson); Hemlock, July 17, 1897, *Jepson* (J.).

Oregon: Roseburg, Oct. 2, 1881, *Pringle* (MBG); Grant's Pass, July 24, 1915, *Canby 103* (OAC); 4 mi. north of Agnes, June 25, 1917, *Nelson 1502* (GH); by the river, Grant's Pass, July 2, 1887, *T. Howell*, in part (US, 43117).

M. subserrata Greene is based upon a specimen collected by G. W. Dunn in Sonoma County, June, 1890. Only a photograph of this plant has been seen by the author.

c. Subsp. **Sheltoni** (Torrey), comb. nov.

Monardella Sheltoni Torrey in Durand, Pl. Pratten., Jour. Acad. Nat. Sci. Phila. II. **3**: 99. 1855.

M. villosa var. *glabella* Gray in Bot. Calif. **1**: 593. 1876; Syn. Fl. N. Am., ed. 2, **2**[1]: 357. 1886 (in part).

M. reflexa Howell, Fl. Northwest Am. 549. 1901.

M. dentata Rydb. Bull. Torr. Bot. Club **31**: 641. 1904.

M. coriacea Heller, Muhlenbergia **1**: 35. 1904.

Madronella coriacea Heller, Muhlenbergia **1**: 138. 1906.

Madronella dentata Rydb. Bull. Torr. Bot. Club **33**: 150. 1906.

Madronella amabilis Heller, in herb. (12567). 1916.

Stems *puberulent or glabrous* in the upper nodes; leaves ovate, tending to *lanceolate*, puberulent or *nearly glabrous*, blades commonly 2–2.5 cm. long, subcuneate at the base, *entire* or obscurely serrate, tapering into a petiole 2–5 mm. long; bracts lanceolate, reflexed, short-pubescent; corolla 12–20 mm. long, purple to whitish, the lobes of the upper lip about half its length, those of the lower its full length.

Specimens examined:

California: Klamath R., Humboldt Co., 1500 ft., June, 1901, *Chandler 1522* (GH; MBG; US); Castella, Shasta Co., July 24, 1912, *Eastwood 1369* (GH; US); Nevada Co., June 20–22, 1912, *Eastwood 581* (GH; MBG; US; type locality); Sierras, 1872, *A. Gray* (GH); no locality stated, *Bridges 307* (US; GH); no data other than this: "M. Sheltoni Torr. in herb.," in Dr. Gray's hand; the author's conception of *M. Sheltini* is based upon this plant together with the description and other plants from the type locality; Indian Valley, Plumas Co., Aug., 1896, *Austin* (MBG); Summit, between Mad and Trinity Rivers, on Eureka Red Bluff Road, July 22, 1916, *Abrams 6181* (DH); between the McCloud and Sacramento Rivers, Shasta Co., June 24, 1916, *Heller 12447* (MBG; GH; US; OAC; distributed as a form of *M. gigantea* Heller; varies considerably within the collection); Shasta River hills near Klamath River, June 27, 1909, *Butler 938* (MBG); Hornbrook, Siskiyou Co., July 6, 1903, *Copeland 3497*

(GH; US; MBG); Miller's Ranch, summit between Gilroy and Watsonville, May, 1903, *A. D. E. Elmer 4647* (US; MBG; OAC); Tassajara Hot Springs, June, 1901, *Elmer 3224* (MBG; US); Loma Prieta, Santa Clara Co., July 22, 1893, *Dudley* (DH); slope above Round Meadow, Fresno Co., 7300 ft., July 25, 1914, *Smiley 588* (GH); Sisson, Aug. 20, 1889, *Sheldon* (MBG; NYS); Grass Valley, 3000 ft., July, 1892, *Hansen 439* (MBG); Greenville, July 12, 1907, *Heller & Kennedy 8824* (US; GH; MBG); Willow Creek, Humboldt Co., June 16, 1918, *Abrams 7183* (DH); near Nevada City, July 14, 1905, *Heller 8113* (GH; US; type locality of *M. Sheltoni*); west side of Trinity River near Willow Creek, Humboldt Co., 600 ft., July 9, 1911, *Tracy 3476* (GH; US); Plumas Co., May, 1894, *Ames* (GH); Little Chico canyon, May, 1896, *Austin 803* (MBG; US); Russian River at Healdsburg, July 8, 1902, *Heller 5812* (MBG; GH; *type collection* of *M. coriacea* Heller); Napa, 1899, *Smyth* (GH; approaches the large-leaved forms of subsp. *euvillosa,* the same with the two following); Ukiah, April 22, 1891, *Fritchey* (MBG); Calaveras Big Tree Road, Aug. 1890, *Jepson 40 c* (J); Huntington Lake, Fresno Co., 7000 ft., *Grant 1157* (J); Vichey Springs, June 22, 1891, *Fritchey* (MBG); Summit, Butte Co., June 28, 1897, *Austin 1126* (US); Clio, Plumas Co., Aug. 27, 1910, *Eggleston 6213* (US); Little Chico Creek, 2000 ft., July 5, 1900, *Leiberg 5024* (US).

Oregon: Grant's Pass, June 24, 1884, *T. Howell 244* (GH; US); by the river, Grant's Pass, July 2, 1887, *T. Howell,* in part (OAC, 8981; MBG, 114312); gravel bar along Chetco River, 7 mi. above Harbor, Curry Co., July 19, 1919, *Peck 8910* (GH; MBG); by the river, Grant's Pass, July 2, 1887, *T. Howell* (MBG; NYS; OAC); Snow Camp, Curry Co., 4000–4250 ft., July, 1916, *Thompson 7* (DH); Cherry Creek Flat, Klamath Co., Aug. 15, 1908, *Rose 265* (DH); Grant's Pass, June 20, 1886, *Henderson 805* (OAC); Big Butte Creek Crossing, 30 mi. east of Medford, Jackson Co., Aug. 27, 1916. *Heller 12567* (MBG; GH; US; OAC; *type collection* of *M. amabilis* Heller); Sykes Creek, Jackson Co., July 14, 1892, *Hammond 325* (MBG); Takilma, Josephine Co., June 25, 1918, *Peck 7981* (GH); Wimer, Jackson Co., July 14, 1892, *Hammond 325* (US); Waldo, dry open forest of *Pinus ponderosa,* 1 mi. west of town, July 18, 1924, *Hall 11990* (UC).

M. dentata Rydb., based upon an unnumbered sheet in the Herbarium of the New York Botanical Garden, is unquestionably the plant which grows in the lower altitudes of the Sierra Nevada in central California. That it occurs on Gray's Peak in Colorado as reputed is very doubtful, and until further material is forthcoming such an extension of the range should not be made. It should be noted in this connection that Dr. Torrey visited the central Sierras several years earlier and that it is not impossible that an exchange of labels has taken place. The present printed label of the type sheet reads: "Herbarium of Columbia College, New York. Plants collected on Gray's Peak, Colorado Territory in August and September, 1872, by J. Torrey" and below in an unidentified hand "Monardella odoratissima Bth." The label is not contemporary with the collection. The plant thus labeled is strikingly like the collection of *M. villosa* subsp. *Sheltoni* made by Bridges in California (US; GH).

d. Subsp. **neglecta** (Greene), comb. nov.

Monardella neglecta Greene, Pittonia **5**: 82. 1902.

Madronella neglecta Greene, Leaflets Bot. Obs. **1**: 169. 1906.

Stems puberulent to glabrous in the inflorescence, purple; leaves ovate or oblong, obtuse, the blades 1–1.5 cm. long, subcuneate at the base, serrate in some at least, tapering into a petiole 2–5 mm. long; *bracts ovate, acute, membranous, only the outer foliaceous, and reflexed, the innermost purple, pubescent to glabrous, ciliate,* about equal to the calyces; calyx 6–8 mm. long, pubescent with spreading trichomes; corolla 12–14 mm. long, rose-purple, the lobes of the upper lip about one-half its length, that of the lower free nearly to the base.

Specimens examined:

CALIFORNIA: Mt. Tamalpais, 1876, *Vasey* (GH; US, TYPE of *M. neglecta* Greene); Tiburon, Marin Co., June 9, 1912, *Eastwood 315* (GH; US); Mt. Tamalpais, July 29, 1912, *Eastwood 1517* (GH; MBG; US); Crystal Springs Lake, June 23, 1913, *Suksdorf 312* (GH); south side of Mt. Tamalpais, July 17, 1913, *Suksdorf 581* (GH); Rock Spring Trail, Tamalpais, July 2, 1905, *K. Brandegee* (UC); Tiburon, Marin Co., on a rocky slope facing San Francisco Bay, June 3, 1909, *Walker 1727* (GH; MBG; US).

The specimen collected by Vasey on Mt. Tamalpais is cited with the description of *M. neglecta* Greene. In the Greene Herbarium a fragment of this plant is mounted on the same sheet with a specimen collected by G. W. Dunn in Marin Co., July 22, 1890. The latter collection is designated as the type in Greene's handwriting. Only a photograph of this sheet has been seen by the author.

Subsp. *neglecta* is exceedingly variable, in habit, in pubescence, and in the texture of the bracts. When most vigorous it is scarcely to be distinguished from subsp. *Sheltoni*. A villous form, scarcely separable from subsp. *euvillosa* presumably collected with or near average plants, has been observed.

5. **M. hypoleuca** Gray, Bot. Calif. **2**: 476. 1880; Syn. Fl. N. Am., ed. 2, **2**[1]: 356. 1886; Abrams, Muhlenbergia **8**: 39. 1912; Davidson & Moxley, Fl. South. Calif. 314. 1923.

Monardella robusta Elmer, Bot. Gaz. **39**: 46. 1905.

Madronella hypoleuca Greene, Leaflets Bot. Obs. **1**: 169. 1906.

Perennial, suffrutescent, 30–50 cm. tall, erect or *trailing*, "prostrate or supported by other growth" (Elmer), the older stems glabrous, light brown, the bark checking longitudinally, the younger branches simple, purplish, villous near the glomerule; leaves *rhomboidal-lanceolate*, the smaller oblong, 2–4 cm. long, entire, obtuse, *green and glabrous above, the veins impressed, covered beneath with a white felt-like tomentum*, the margin revolute, petioles 3–10 mm. long; glomerules 3–4 cm. broad, compact, the bracts ovate, shorter than the calyces, membranous rather than foliar, but firm, tomentose; calyx 6–7 mm. long, scarious below, green and villous above, veins 13–15, teeth ovate-triangular, acute; corolla pale lavender or white, 15–16 mm. long, the tube 10 mm. long, the upper lip equal to or somewhat longer than the lower, the lobes about half its length, those of the lower lip one-fourth its length, tapering but little, blunt; stamens well exserted, the anthers divergent, the connective equilateral, well developed.

Specimens examined:

California: mountain drive, Santa Barbara, Aug. 21, 1904, *Abrams 4149* (GH); dry ridges, Santa Monica Mts., Topanga Canyon, June, 1907, *Hasse;* Rattlesnake Canyon, Santa Barbara, Aug. 1902, *Elmer 3728* (US; MBG; *type collection* of *M. ro-*

busta Elmer, TYPE in DH); San Bernardino Co. (Gray, Syn. Fl.), 1876, *Parry & Lemmon 330* (GH; TYPE); San Juan Capistrano, July, 1882, *Nevin 688* (GH); Malibu Canyon, Los Angeles Co., Aug. 5, 1898, *Barber* (UC); Rincon Cr., Ventura Co., Sept. 19, 1922, *Baer* (BH); trail, Trabuco canyon to Santiago Peak, Santa Ana Mts., Orange Co., 3000–4000 ft., Sept. 7, 1923, *Munz 7742* (BH).

6. M. lanata Abrams, Muhlenbergia **8:** 39. 1912; Davidson & Moxley, Fl. South. Calif. 313. 1923.

Perennial, suffrutescent, 30–50 cm. tall, erect, branching at the base, the branches purplish, villous to lanate; *leaves oblong, the smaller even oblanceolate or subspatulate,* 2–4 cm. long, very obtuse, *short-pubescent to lanate above, the veins not prominent, covered beneath with a dense white felt-like tomentum, the margin strongly revolute,* petioles 3–10 mm. long; glomerules 3–4 cm. broad, compact, the bracts ovate, shorter than the calyces, membranous rather than foliar, but firm, tomentose; calyx 6–7 mm. long, scarious below, green above, lanately villous, veins 13–15, teeth ovate, triangular, acute; corolla pale lavender or white, 15–17 mm. long, the tube 10 mm. long, the upper lip equal to or somewhat longer than the lower, the lobes coalesced about half its length, those of the lower lip one-fourth its length, tapering but little, blunt; stamens well exserted, the anthers divergent, the connective equilateral, well developed.

Specimens examined:

California: Descanso Grade near the top, July 19, 1906, *K. Brandegee* (UC, 104626, TYPE); Potrero Mts., July 23, 1883, *Orcutt 996* (GH; UC); San Diego Co., near Alpine, July 10, 1912, *Abrams 4896* (UC; US; BH; DH); Palomar Mt., back of Pala, July, 1901, *Schellenger* (UC; upper surface of leaves glabrate).

M. lanata is apparently distinct from *M. hypoleuca* which it most nearly resembles. The specimen collected by Schellenger suggests strongly a continuous range of variation between the two. If such is found to be the case when *M. lanata* is better known, it would best be considered as a subspecies of *M. hypoleuca.*

7. M. viridis Jepson, Fl. West. Middle Calif., ed. 1, 465. 1901, and ed. 2, 364. 1911.

M. ledifolia Greene, Pittonia **5:** 81. 1902.

Madronella ledifolia Greene, Leaflets Bot. Obs. **1:** 169. 1906.

Madronella viridis Arthur, Torreya **21:** 12. 1921.

Perennial from a short woody stem, branching at the base, erect, or decumbent, the sterile branches numerous, short, the fertile branches slender, 6–12 inches tall, whitish puberulent; leaves *rhomboidal lanceolate, 1–2 cm. long, obtuse, canescent with a minute but dense pubescence, dark green above, white beneath,* subentire, the margin distinctly and narrowly revolute, subcuneate at the base and narrowed to a margined petiole 2–3 mm. long; glomerules 2 cm. broad or less, globose, the bracts about equal to the calyces, membranous or subfoliar, firm, ovate-lanceolate, acute, softly pubescent; calyx 7 mm. long, rather shaggy-pubescent or villous; corolla 14–16 mm. long, the upper lip somewhat shorter, the lobes about half its length, those of the lower lip nearly free, *all tapering evenly,* but blunt; stamens subequal, about equal to the lips, the anthers small, *.75 mm.,* the sacs divergent, the connective equilateral.

Specimens examined:

California: Sonoma County, ? 1894, *Krauss* (DH); Upper Conn Valley, Napa Range, Oct. 13, 1894, *Jepson 70d* (J, type; fragment UC; type of *M. ledifolia* Greene in Greene Herb.); Mt. St. Helena, 1893, *Jepson 32f* (J); Mt. Hanna, Lake Co., July 15, 1897, *Jepson 100j* (J).

M. ledifolia Greene is based upon the type collection of *M. viridis.* The species is distinct but apparently restricted to the St. Helena range.

8. M. saxicola Johnston, Bull. South. Calif. Acad. Sci. **28:** 19. 1921.

Perennial from decumbent, suffrutescent stems, branches erect, 30–40 cm. tall, branching below if at all, purple, puberulent; leaves *rhomboidal-lanceolate,* the smaller oblong, 2–5 cm. long, obtuse, *green and glabrous above,* pubescent beneath with a *silvery microscopic tomentum,* the margin revolute, the *veins impressed,* the blade narrowed at the base to a petiole 2–7 mm.

long; glomerules 2.5–3 cm. broad, bracts ovate, acute or obtuse, about equal to the calyx, membranous, but *firm* and rather thickish, pubescent; calyx 8–10 mm. long, rather slender, short-pubescent to villous, *veins 10–11*, teeth ovate-triangular, acute, hirsute within; corolla lavender to rose-purple, 14–17 mm. long, the tube 10 mm., the lobes ribbon-like but tapering slightly, blunt, those of the upper lip less than half its length, those of the lower lip three-fourths its length or more; stamens well exserted, the anther-sacs divergent, the connective equilateral, well developed.

Specimens examined:

CALIFORNIA: at start of old trail to the flats, near Brown's Flats, San Antonio Mts., 5000 ft., Sept. 1, 1918, *Johnston 2133* (BH, TYPE; DH); south spur of Cucamonga Peak, common among rocks on ridge crest, 5200 ft., June 30, 1918, *Johnston 2050* (DH; BH); head of Evey Canyon on Sunset Trail, San Antonio Mts., 4750 ft., July 1, 1917, *Johnston 1440* (BH).

Apparently distinct but very similar to *M. viridis* Jepson, from which it differs chiefly in leaf character, the leaves being larger, coarser, glabrous above, with a very minute, dense silvery tomentum on the lower surface. They are less cuneate and more rounded at the base and the veins are noticeably impressed. Since the author has seen no intergrading forms and since *M. saxicola* is geographically quite distant from *M. viridis*, it has seemed preferable to retain this as a species until it may be more extensively studied.

9. M. cinerea Abrams, Muhlenbergia 8: 33. 1912; Fl. Los Angeles, ed. 2, 317. 1917; Davidson & Moxley, Fl. South. Calif. 313. 1923.

Perennial, woody at the base, the stem covered with a brown bark which flakes and falls away; branches several, spreading, 5–15 cm. long, cinereous; leaves ovate-lanceolate, 5–11 mm. long, obtuse or acute, *denticulate* rather than serrate, sometimes entire, *cinereous or hoary on both surfaces with a soft subvillous pubescence giving the whole plant a bluish cast, sessile;* glomerules 1.5–2 cm. broad, compact, purplish, bracts ovate to elliptical, acute or shortly acuminate, about the length of the calyces, *membranous,* *pinnately veined, sparingly villous, purplish;* calyx 7–9 mm. long, villous, 12–15-nerved, the teeth 2 mm. long, slender, acute, villous within; corolla rose-purple, 13–14 mm. long, lobes lanceolate, those of the upper lip two-thirds its length, those of the lower lip the length of the lip, the lower stamens slightly exceeding the lobes, a third longer than the upper pair, the anthers divergent, the connective equilateral, well developed.

Specimens examined:

California: Little Baldy, 9500 ft., "common among the rocks," Aug. 22, 1917, *Johnston 1693* (GH; UC; BH); south slope of Baldy, 6000 ft., dry rocky ground, July 4, 1917, *Johnston 1422* (DH; GH; UC; BH); Icehouse Canyon, rocky places, 8300 ft., July 31, 1917, *Johnston 1458* (BH; UC); N. Fork San Antonio, 8000 ft., July 28, 1917, *Johnston 1571* (UC; BH); Mt. Baldy Lookout, 7000 ft., June 20, 1917, *Johnston 1261* (UC); Mt. Baldy, 8750 ft., July 4, 1917, *Johnston 1449* (UC); Mt. Baldy, 10,000 ft., July 4, 1917, *Johnston 1420* (UC); Mt. San Antonio (Mt. Baldy), 9000 ft. or more, July 24, 1901, *Abrams 1928* (BH; *type collection,* TYPE in DH); saddle between Baldy and Little Baldy, dry rocky slopes, 9400 ft., July 21, 1922, *Munz 6114* (BH); Mt. Baldy, 7500 ft., June 8, 1918, *Peirson 182* (J).

A very puzzling species of restricted habitat. The degree of variability within its altitudinal distribution is considerable, and while some forms suggest *M. linoides* subsp. *stricta* and others *M. odoratissima* subsp. *australis,* it still appears to be distinct.

§ Section III. Odoratissimae

10. M. odoratissima Benth. Lab. Gen. et Sp. 332. 1834, in DC. Prodr. **12:** 190. 1848; Gray, Proc. Am. Acad. **11:** 101. 1876; Bot. Calif. **1:** 594. 1876; Syn. Fl. N. Am., ed. 2, 2^1: 357. 1886.

Perennial from a woody, often contorted and decumbent stem, the bark dark brown, splitting and falling away; branches erect or ascending, unbranched, seldom with short, erect, sterile branchlets in the upper nodes, of variable stature, 10–60 cm. tall, commonly 25–30 cm., pubescence close and short, canescent, or cinereous or glaucous-like, but never silvery; *leaves lanceolate,* varying, on the one hand, to ovate and, on the other hand, to oblong, 1–3 cm. long, entire, rarely obscurely serrate, pubescent or glabrate, the pubescence *close and short*, never villous but *canescent, cinereous or glaucous-like*, never silvery, sessile or tapering behind to a petiole 1–3 mm. long (7 mm. in extreme forms); glomerules 1–5 cm. broad; bracts *membranous*, ovate or rotund, obtuse or acute, variously shaded with purple, densely short-villous or tomentose, or puberulent, strongly *ciliate on the margin* in most; calyx 6–10 mm. long, 13-nerved, scarious below, green and villous or hirsute above, teeth ovate, triangular, acute, hirsute within; corolla 1–2 cm. long, rose-purple to pallid, the tube retrorsely puberulent, the *lobes lanceolate rather than linear-oblong*, rounded to a rather obtuse point, those of the upper lip one-third to one-half its length, those of the lower lip seldom equaling it, for the most part about three-quarters its length; filaments retrorsely hispidulous at the base, the anther-sacs divergent, the connective equilateral, well developed; nutlets oval-oblong, about 2 mm.

Key to the Subspecies

A. Leaves appearing nearly or quite glabrous, tending to appear glaucous, usually more than 2 cm. long.
  a. Bracts tending to ovate or rotund, pubescent.........subsp. *euodoratissima*
  b. Bracts tending to elliptical or oblong, puberulent...........subsp. *glauca*
B. Leaves distinctly pubescent.
  a. Leaves hoary, whiter beneath, pubescence dense in typical specimens....................................subsp. *discolor*
  b. Leaves cinereous or green, but not markedly whiter beneath.
    α. Bracts usually exceeding the calyces and short-acuminate..................................subsp. *australis*
    β. Bracts equal to or shorter than the calyces, acute or obtuse.
      1. Glomerule .5–1.5 cm. broad, seldom 2 cm........subsp. *parvifolia*
      2. Glomerules 2–3 cm. broad, seldom less.
        I. Calyces woolly; pubescence about the same on both leaf surfaces..................subsp. *pallida*
        II. Calyces hirsute; pubescence on lower leaf surface usually longer and soft........subsp. *pinetorum*

It was an unfortunate circumstance that the historical type of *M. odoratissima* should have been collected at the extreme northern station, not only for the species but for the genus and in a locality which is not readily accessible. By reason of the great variability of the species, and because the described "type" was an extreme form and but little known, the synonymy which has grown up within the species is unusually large. If one were to consider the historical type-sheets alone, he might construct an artificial key which would satisfactorily separate not only those sheets but not a few others which by themselves appear "distinct." Yet when he came to apply such a key to extensive herbarium material or to the plants in the field, it is the author's opinion that the user of such a key would find himself driven to the creation of a still larger number of new "species" in order to classify his material consistently.

By reason of the fact that the species covers a wide range of territory, and since it does present differences in different parts of the range, an earnest but unsuccessful effort was made to find satisfactory criteria which would serve to divide the group into two or more clean-cut divisions. The subspecies here described represent the nearest approach to such an ideal. For convenience they might be called species and treated as such, yet it is the opinion of the author that no advantage would accrue, so numerous are the connecting forms, so profound is the effect of the environment, especially in numerous montane-desert stations where great extremes may occur within a relatively small radius of map distance and so close are the relationships of the subspecies.

a. Subsp. **euodoratissima,** nom. nov.

Monardella odoratissima Howell, Fl. Northwest Am. 550. 1901.

M. glabra Nutt., collected near Walla Walla, Mss., ex Benth. DC. Prodr. **12:** 190. 1848.

Madronella odoratissima Piper, Contr. U. S. Nat. Herb. **9:** 493. 1906; Piper & Beattie, Fl. Southeast. Washington, 216. 1914.

Branches thinly pubescent above, hardly cinereous; leaves lanceolate, tapering at the base but *subsessile,* averaging 2 cm., *green, appearing glabrous,* but shortly and sparingly pubescent; bracts ovate to rotund, about equal to the calyces, obtuse for the most part, pubescent on the veins, ciliate, *calyx woolly pubescent around the teeth;* corolla about 15 mm. long, the lobes slender.

Specimens examined:

WASHINGTON: near the narrows above Kettle Falls on the Columbia, *Douglas* (TYPE at Kew, a portion and photograph at MBG); Meyers Falls, Stevens Co., Aug. 22, 1902, *Kreager 499* (US; GH; from the type locality and a very close match for the type); Blue Mts., June 26, 1897, *Horner 408* (US); Blue Mts., Columbia Co., July 26, 1897, *Horner B408* (GH; the same as the preceding ?); Blue Mts., Walla Walla Co., 5000 ft., Aug. 2, 1896, *Piper* (GH); Blue Mts., Walla Walla Co., July 15, 1896, *Piper* (BH); Colville Nat. Forest, 3500 ft., Aug. 6, 1912, *Wright* (US); near Mt. Hood on the Columbia R., Aug. 4, 1920, *Suksdorf 10568* (GH).

OREGON: Clearwater, no date, *Spaulding* (GH); no locality or date, *Geyer 468* (GH; cited by Bentham); Pendleton, dry thicket, July 16, 1915, *Peck* (GH); Blue Mts., between Ukiah and Long Creek, 4600 ft., July 26, 1917, *Lawrence 842* (DH; US); Gibbon (Bingham Springs Station), 530 m., June 28, 1916, *Eggleston 12845* (US); Milton, Umatilla Co., 1000 ft., Aug. 26, 1896, *Brown 43* (RMH; MBG; US); Elgin, Aug. 15, 1899, *Shear 5587* (US).

NEVADA: Monitor Range, 8000 ft., Sept.–Oct., 1878, *Phillips & Sargent* (GH); 7 mi. east of Ely, 2400–3000 m., *Hitchcock 1306* (US); the two preceding are intermediate with subsp. *glauca*, but are perhaps closer to this.

NEW MEXICO: Mogollon Mts., on or near the west fork of the Gila R., Socorro Co., 8500 ft., Aug. 23, 1903, *Metcalfe 565* (US; GH; MBG; can in no way be distinguished from the Blue Mt. plants).

b. Subsp. **discolor** (Greene), comb. nov.

Monardella discolor Greene, Pittonia **2**: 24. 1889; Howell, Fl. Northwest Am. 550. 1901.

M. nervosa Greene, Pittonia **4**: 322. 1901.

Madronella discolor Greene, Leaflets Bot. Obs. **1**: 169. 1906; Piper, Contr. U. S. Nat. Herb. **9**: 493. 1906; Piper & Beattie, Fl. Northwest Coast, 309. 1915.

Madronella nervosa Greene, Leaflets Bot. Obs. **1**: 169. 1906; Piper, Contr. U. S. Nat. Herb. **11**: 493. 1906.

Madronella odoratissima Greene, Leaflets Bot. Obs. **1**: 169. 1906; Rydb. Fl. Rocky Mts., ed. 2, 751. 1922.

Branches pubescent above, scurfy and cinereous, leaves *ovate-lanceolate,* tending to ovate, rather abruptly tapering behind but *subsessile,* averaging about 2 cm., often less, obscurely crenate-serrate, *hoary to cinereous with a dense minute tomentum;* bracts ovate or oblong, about equal to the calyces, obtuse, woolly-pubescent in typical specimens, at least pubescent, the margins strongly ciliate; *calyx woolly-pubescent;* corolla averaging about 13 mm., the lobes slender.

Specimens examined:

WASHINGTON: north fork of Cowiche Creek (Yakima region), July 21, 1901, *Cotton 464* (US); Alkali Lake, Douglas Co., 335 m., July 7, 1893, *Sandburg and Leiberg 413* (US); no locality stated, 1889, *Vasey 466* (GH; US); Wenatchee, July 28, 1896, *Whited 195* (US); White Bluff Ferry, Upper Columbia River, Aug. 11, 1892, *Lake & Hull 705* (GH; MBG); Rock Island, July, 1893, 2000–3000 ft., *Sandburg & Leiberg* (US; MBG; RMH); Yakima region, Cascade Mts., 1882, *T. S. Brandegee 235* (US; MBG; GH); Mt. Rainier, moraine of Cowlitz Glacier, in loose rock, 5000 ft., Aug. 1895, *Piper 2078* (US); Yakima, 1877, *T. J. Howell* (GH); bluffs east side of Columbia, below the Chelan, Oct. 13, 1880, *Watson 328* (GH; a specimen on the same sheet collected "on the bluffs of the Columbia R. above the Chelan, west side," Oct. 12, 1880, by the same collector and bearing the same number is very close to subsp. *euodoratissima*); stony bottoms of canyons, Rattlesnake Mts., 2500 ft., Aug. 2, 1902, *Cotton 760* (US; GH; MBG); along creek south of Ellensburg, June 27, 1897, *Whited 547* (US; OAC); gravelly banks of the Yakima near Clealum, Aug. 13, 1889, *Greene* (FM; UC; *type collection* of *M. discolor* Greene); gravelly shores of Yakima River, June, 1897, *Elmer 373* (US; MBG; annoted by Greene as being "*M. discolor* Greene exactly and from near original station"); southeast side of Mt. Rainier, 7000 ft., *Allen* (GH); Ellensburg, July, 1898, *Elmer* (MBG); Mt. Adams, 6000–7000 ft., Aug. 31, 1882, *Suksdorf* (FM); Umtanum Creek, Yakima Co., July 26, 1923, *St. John 3108* (S); Coulee City, Grant Co., June 25, 1923, *St. John 3107* (S); 18 mi. north of Yakima, dry stony soil in belt of *Purshia* and *Artemisia tridentata,* July 23, 1924, *Hall 12009* (UC).

OREGON: Mt. Hood, among rocks, 6500 ft., Aug. 25, 1899, *Barber* (GH; RMH); The Dalles, June, 1881, *T. Howell* (OAC); no locality, collected by (?) *Cooper, Stevens Exp.* (GH). The following specimens from eastern Oregon are most nearly related to *M. odoratissima* subsp. *discolor* but have the pubescence much reduced, in this respect resembling subsp. *glauca;* the habit, shape of the leaves and general aspect is that of subsp. *discolor*, however; some suggest subsp. *euodoratissima:* Gilliam Co., near forks of Cottonwood Canyon, 3400 ft., Sept. 7, 1894, *J. B. Leiberg 885* (US; GH; UC); near dry run between Bear Buttes and Button Springs, Crook Co., 4400 ft., Aug. 24, 1894, *J. B. Leiberg 797* (US; GH; FM; UC); White Horse Mts., Aug., 1901, *D. Griffiths & E. L. Morris 416* (US); near Guano Ranch, Harney Co., 4350 ft., July 24, 1896, *F. V. Coville & J. B. Leiberg 9* (US).

c. Subsp. **glauca** (Greene), comb. nov.

Monardella glauca Greene, Pittonia **4**: 321. Nov. 7, 1901.

M. modocensis Greene, Pittonia **4**: 321. Nov. 7, 1901.

M. purpurea Howell, Fl. Northwest Am. 550. Nov. 20, 1901.

M. rubella Greene, Pittonia **5**: 84. 1902.

M. ovata Greene, Pittonia **5**: 82. 1902.

M. ingrata Greene, Pittonia **5**: 83. 1902.

Madronella modocensis Greene, Leaflets Bot. Obs. **1**: 169. 1906.

Madronella rubella Greene, Leaflets Bot. Obs. **1**: 169. 1906.

Madronella glauca Greene, Leaflets Bot. Obs. **1**: 169. 1906.

Madronella ovata Greene, Leaflets Bot. Obs. **1**: 169. 1906.

Madronella oblongifolia Rydb. Bull. Torr. Bot. Club **36**: 686. 1909; Fl. Rocky Mts., ed. 2, 751. 1923.

Madronella sessilifolia Rydb. Bull. Torr. Bot. Club **36**: 685. 1909; Fl. Rocky Mts., ed. 2, 751. 1923.

Madronella purpurea A. Nelson, Bot. Gaz. **52**: 71. 1911.

Madronella ingrata Greene, Leaflets Bot. Obs. **1**: 169. 1906.

Branches puberulent, usually *glaucous-appearing*, purple or whitish; leaves ovate-lanceolate, elliptical or oblong, 1.5–4 cm. long, seldom truly ovate, variable on the same plant in size and shape, *narrowed at the base to a margined petiole* 1–5 mm. long, glabrate, commonly *glaucous-appearing* due to a microscopic puberulence, the uppermost leaves commonly subsessile; bracts ovate, with a tendency for the outer to become orbicular and *the inner oblong*, puberulent, purplish, ciliate; calyx pubescent, *hirsute around the teeth,* seldom woolly; corolla 1–2 cm. long, the lobes noticeably tapering.

Specimens examined:

OREGON: summit of Cascade Mts., Ashland-Klamath Falls Rd., July, 1920, *Peck 9265* (GH; MBG); coast mountains near Waldo, June 13, 1884, *T. J. Howell* (US; GH; type locality of *M. purpurea* Howell and not improbably the collection referred to by him); Ashland, July 8, 1886, *Henderson 805* (OAC); Cherry Creek, 4150 ft., dry woods, July 23, 1899, *Leiberg 4306* (US); rocky peak 12 mi. southeast of Port Orford, July 25, 1919, *Peck 8934* (MBG; GH); Siskiyou Mts., 12 mi. south of Waldo, July 2, 1918, *Peck 8396* (GH); 8 mi. south of Waldo, June 14, 1904, *Piper 6234* (US); Eight Dollar Mt., Josephine Co., June 12, 1904, *Piper 5341* (US); Eastern Cascade Mts., Klamath Co., June 30, 1902, *Cusick 2846* (GH; MBG; US); 2 mi. southeast of Oregon Caves, Josephine Co., July 16, 1918, *Peck 8369* (GH); Keno, Klamath Co., July 9, 1920, *Peck 9413* (GH); Buck Lake, Klamath Co., July 24, 1897, *Coville & Applegate 14* (US); Siskiyou Mts., July 8, 1887, *T. Howell 1250* (NYS; OAC; MBG); Siskiyou, 4100 ft., June 26, 1920, *Fischer 38* (US); Baker Co., dry run of canyon of East Pine Creek, 3 mi. northeast of Cornucopia, Aug. 27, 1915, *Peck 5538* (GH); eastern Oregon, June 21, 1898, *Cusick 1956* (GH; MBG; US; *type collection* of *M. glauca* Greene); Wallowa Co., east of Tollgate Ranger Station, Wenaha Nat. For., 4500 ft., Aug. 3, 1916, *Lawrence* (US).

CALIFORNIA: Mt. Shasta, Sept. 7, 1897, *Canby 221* (GH; US); Gold Lake, Sierra Co., 1960 m., Aug. 28–29, 1910, *Eggleston 6272* (US; this and the next have the inflorescence characters of subsp. *pallida* and the herbage of subsp. *glauca*); Gold Lake, Sierra Co., 1960 m., Aug. 28–29, 1910, *Eggleston 6269* (US); Siskiyou Co., Mt. Eddy, 4500 ft., July 16, 1915, *Heller 12105* (US; GH; OAC; MBG; US); Baxter Gulch, Trinity Co., June 17, 1914, *Yates 441* (UC); Siskiyou Co., Mt. Hilt, *Rexford* (US); Shasta Co., near Bald Mt., south of Fall River Mills, 3800 ft., June, 1903, *Hall & Babcock 4262* (DH); south fork of the San Joaquin River, Fresno Co., 6700 ft., July, 1900, *Hall & Chandler 638* (US; MBG); Yreka, Aug., 1876, *Greene* (FM; authentic material of *M. modocensis* Greene); Buck Mt., near Summit, Humboldt Co., 5500 ft., July 31, 1912, *Tracy* (UC; US; suggests subsp. *pallida*); Butte Co., Chico Meadows, 4000 ft., *Heller 11604* (OAC; GH; US; part of the collection suggests *M. villosa* subsp. *Sheltoni*); Butte Co., near Stirling, 3400 ft., June 7, 1913, *Heller 10792* (GH; US; MBG); Siskiyou Co., Humbug Mt., 4000 ft., May 23, 1910, *Butler 1393* (US; RMH; MBG; GH); Gasquet, French Hill, Del Norte Co., Sept. 14, 1912, *Eastwood 2200* (US; GH); ridge between Eagle & Bear Mt., Modoc Forest, 8000 ft., Aug. 18, 1918, *Smith 1046* (J); Clear Creek, Butte Co., near Cherokee, 175 feet., Apr. 15–30, 1897, *Brown 43* (US); Yreka, June 30, 1876, *Greene 910* (MBG; authentic material of *M. modocensis* Greene); Sisson, Siskiyou Co., 3555 ft., June 1–10, 1897, *Brown 381* (MBG; US; *type collection* of *M. ovata*, TYPE in US, an extreme form); Shasta Springs, Siskiyou Co., June 13, 1905, *Heller 8018* (GH; US); Dorleska, Trinity Co., 6500 ft., July, 1909, *Hall 8602* (US); Hot Spring Valley, Plumas Co., July 7, 1897, *Austin 1123* (US); Mt. Bidwell, Modoc Co., Aug. 27, 1903, *Manning 350* (US; suggests subsp. *discolor* as it occurs in eastern Oregon); Tuolumne Meadows on south gravelly slopes at base of granite dome, at cascades of Dana Fork, 8700 ft., Aug. 5, 1923, *Hall* (UC); Middle Fork San Joaquin River, 7600 ft., open slopes of *Abies magnifica* forest near Hot Spr., Aug. 30, 1923, *Hall 11891* (UC; inflorescence of subsp. *glauca*, foliage of subsp. *pallida*).

NEVADA: Washoe Co., log railroad north of Verdi, 5300 ft., June 30, 1913, *Heller 10891* (GH; US; MBG; type locality of *M. rubella;* the plants of this collection closely resemble the type); Washoe Co., Hunter Creek, 6000 ft., Aug. 2, 1912, *Kennedy* (US; GH; MBG); Washoe Co., Mt. Rose, 9300 ft., Aug. 26, 1911, *Heller 10346* (US; GH; MBG); Reno, 4500 ft., June 11, 1897, *Jones* (MBG; US); Virginia City, 1863, *Bloomer* (US); Reno, 5000 ft., June 19, 1900, *Stokes* (DH); Genoa, Douglas Co., June 15, 1889, *Lt. Bryan's Exp.* (MBG); Summit Lake Region, July, 1901, *Griffiths & Morris 328* (US); hills, northeast of Reno, 6000 ft., June 20, 1900, *Stokes* (US). The following have the foliage of subsp. *glauca* but approach subsp. *pallida* in the nature of the inflorescence: Hunter's Canyon, vicinity of Reno, 1350–1500 m., July 18, 1913, *Hitchcock 529* (US); Marlette Peak, Washoe Co., 8000 ft., July, 1903, *Hall & Chandler 4567* (US);

King's Canyon, Ormsby Co., 1700–2000 m., June 21, 1902, *Baker 1113* (RMH; US; MBG; GH; referred to *M. glauca* by Greene); Franktown, Washoe Co., 5000 ft., June 28, 1909, *Heller 9795* (GH). The following are intermediate between the longer-petioled forms of California and Nevada and the more nearly sessile forms with oblong leaves, of Utah: Battle Mountain, 1350 m., July 22, 1913, *Hitchcock 576½* (US); Allegheny Creek, 8000 ft., Aug. 6, 1912, *Nelson & Macbride 2172* (US; MBG; GH; RMH); Gold Creek, 6300 ft., July 29, 1912, *Nelson & Macbride 2130* (GH; MBG; US); Ruby Mts. near Blaine P.O., 9300 ft., Aug. 22, 1913, *Heller 11109* (US; GH; MBG); Kingston Canyon, Landor Co., Toiyabe Range, 7500 ft., July 28, 1913, *Kennedy 4202* (GH; the Toiyabe range proper is in Nye Co.); Bunker Hill, Toiyabe Forest, 2250–3400 m., July 29, 1913, *Hitchcock 877* (US).

MONTANA: Mt. Logan, Aug. 1895, *Shear 3164* (US).

IDAHO: Oneido Co., top of ridge on the west of Franklin Basin, July 25, 1910, *Smith 2286* (US); Caribou Forest, Aug. 4, 1913, *Young* (US); Owyhee Co., Silver City, 7000 ft., July 19, 1910, *Macbride 434* (US; GH; RMH; MBG).

COLORADO: Elk Mountains, Pittsburgh, Aug., 1889, *Eastwood* (CSM); Ouray, Ouray Co., Horsethief Trail, July 25, 1915, *Osterhout 5352* (RMH; inflorescence of subsp. *parvifolia*).

UTAH: Cottonwood Canyon near Salt Lake, Sept. 7, 1896, *Stokes* (DH); Clayton Peak, 10,000 ft., Wahsatch Mts., Aug. 12–26, 1903, *Stokes* (US; MBG); Fish Lake, 10,000 ft., Aug. 7, 1894, *Jones 5768* (MBG; US); Aquarius Plateau, 11,000 ft., Aug. 11, 1875, *Ward 549* (MBG; US); Alta, 8500 ft., July 17, 1880, *Jones* (US); 12-mile canyon, Wahsatch Mts., 2700 m., Sept. 3, 1907, *Tidestrom 477* (US); Aquarius Plateau, Aug. 5, 1905, *Rydberg & Carlton 7464* (US); Marysvale, Tate Mine, 11,500 ft., Aug. 28, 1894, *Jones 5940* (US); Wahsatch Mts., 8200 ft., July 18–24, 1902, *Pammel & Blackwood 3782* (GH; MBG); grassy slopes, La Sol Mts., 9000–10,000 ft., July, 1899, *Purpus 6694* (MBG; US); City Creek Canyon, July 17, 1880, *Jones* (RMH); Big Cottonwood Canyon, 10,000 ft., Aug. 7, 1902, *Cooper 348* (RMH); Mt. Terrell, Wahsatch Mts., 3285 m., Aug. 27, 1908, *Tidestrom 1829* (US); Big Cottonwood Canyon, 9000 ft., July 12, 1905, *Garrett*

1404 (US); Abajo Mts. (eastern range), 3000–3300 m., Aug. 17, 1911, *Rydberg & Garrett 9723* (US; RMH); Pine Valley Mts., 7000–8000 ft., May–Oct., 1898, *Purpus 6198* (US); Mt. Nebo, Aug. 15, 1905, *Rydberg & Carlton 7706* (RMH; US; *type collection* of *M. oblongifolia* Rydb., TYPE in N. Y. Bot. Gard.); mountains north of Bullion Creek, above Marysvale, July 23, 1905, *Rydberg & Carlton 7178* (RMH; GH; US); Wahsatch Mts., American Fork, 1877, *Hooker & Gray* (GH); Alta, Wahsatch Mts., 10,000 ft., July 30, 1879, *Jones 1109* (GH).

ARIZONA: Coconino Nat. For., 7900 ft., July 9, 1909, *Pearson 245* (US; inflorescence that of subsp. *parvifolia*).

d. Subsp. **pallida** (Heller), comb. nov.

Monardella pallida Heller, Muhlenbergia **1:** 36. 1904.

Madronella pallida Heller, Muhlenbergia **1:** 138. 1906.

Branches *scurfy-pubescent, cinereous,* but not glaucous-appearing, whitish rather than purple, leaves lanceolate-oblong, 2–3 cm. long, somewhat rounded at the base and narrowed to a *usually margined petiole* 2–8 mm. long, the upper seldom appearing sessile, cinereous with a minute pubescence, but not glaucous-like; bracts *inconspicuous,* broadly ovate, short-pubescent, often woolly, purplish, ciliate, seldom exceeding the calyces, *often decurved* but not reflexed; *calyx short, woolly, often densely so throughout,* the glomerules hence appearing very compact; corolla 1–1.5 cm. long, pallid, the lobes noticeably tapering; tube little or not at all exserted.

Specimens examined:

CALIFORNIA: Round Meadow Camp, Sierra Nevada Mts., 7000 ft., July, 1902, *Grant 2030* (US); ridge near the lower end of Donner Lake (south side), July 17, 1903, *Heller 6959* (GH; US; MBG; *type collection* of *M. pallida* Heller); Kaiser Crest, base of south slope, 8600 ft., July 27, 1914, *Smiley 616* (GH); Clio, Plumas Co., 2080 m., Aug. 27, 1910, *Eggleston 6281* (US); Gabbot Meadow, Stanislaus Forest, Alpine Co., 1970 m., June 19, July 19, 1913, *Eggleston 9689* (US); Gold Lake Trail, Clio, Plumas Co., 1800 m., Aug. 27, 1910, *Eggleston 6246* (US); Farwell Gap, 10,400 ft., Apr.–Sept., 1897, *Purpus 5224* (GH; MBG; US); above Giant Forest, Sequoia Nat. Park, Aug. 24, 1899, *Copeland 19* (US); Grass Lake (Lake Tahoe Region), Aug. 8, 1909, *Mc-*

Gregor 3 (GH; US); Butte Co., Summit above Jonesville, 7000 ft., July 29, 1917, *Heller 12860* (MBG; OAC; US); Camp Echo, Eldorado Co., on the Lincoln Highway, 7000 ft., *A. A. Heller, 12186* (MBG; OAC); Prattville, Plumas Co., *Heller & Kennedy 8774* (GH; US; MBG); Summit, Alpine Co., 9000 ft., Aug., 1892, *Hansen 438* (MBG); Bear River, 5500 ft., Amador Co., July 30, 1896, *Hansen 1934* (US); Scott's Mt., 4000–7000 ft., Aug. 29, 1880, *Engelmann* (MBG); Horse Camp, Mt. Shasta, Aug. 12, 1920, *Heller 13515* (US; MBG); Donner Pass, Placer Co., 7200 ft., July 26, 1919, *Heller 13320* (GH; MBG; US); Eldorado Co., east side of Ralston Peak, above Echo Lake, 7900 ft., Aug. 10, 1911, *Heller 12536* (GH; MBG; OAC; US); vicinity of Tuolumne Meadows, Tuolumne Co., 8500–9500 ft., July 1902, *Hall & Babcock 3626* (DH; perhaps better as subsp. *glauca*); Aspen Grove, Lake Tahoe region, July, 1911, *Hawver* (US); Yosemite Nat. Park, July 21–22, 1915, *Hitchcock* (US); Eagle Lake, Lassen Co., July 28, 1894, *Baker & Nutting* (RMH); south side of Mt. Shasta, 5000–10,000 ft., July 15–31, 1897, *Brown 570* (US; MBG); Plumas Co., 1876, *Ames* (MBG); Mt. Shasta, 6000 ft., Aug. 22, 1880, *Engelmann* (MBG); Colby, Butte Co., July, 1896, *Austin 289* (US); headwaters of Hat Creek, Shasta Co., 2120 m., July 31–Aug. 1, 1911, *Eggleston 7457* (US); near Donner Pass, 1865, *Torrey 403b* (US); Mt. Shasta, July 13–27, 1892, *E. Palmer 2508* (US); Nevada Co., 6300 ft., Aug.–Sept., 1893, *Carpenter* (US); Cisco, Placer Co., 6000 ft., July 1, 1910, *Hall 8731* (US); Mt. Shasta, 8000 ft., Aug.–Sept., 1902, *Grant 796* (US); Mt. Shasta, 9000 ft., Aug. 28, 1889, *Munson & Hopkins* (US); McKinney's, Lake Tahoe, Aug., 1900, *De Con 428* (US); Mt. Shasta, 5000–9000 ft., Sept. 13, 1862, *Brewer 1386* (US); Mineral King, Tulare Co., 2750 m., July 31, 1891, *Coville & Funston* (US); Tar Gap region, Tulare Co., Aug. 2, 1904, *Culbertson 4448* (MBG; GH); Angora Peak, north slope, 7600 ft., July 14, 1913, *Smiley 7* (GH); Sierra Nevada, 1875, *Muir* (MBG); Luthers Pass, 7800 ft., July 27, 1911, *Abrams 4760* (US; GH); Truckee, Nevada Co., June, 1886, *Sonne 284* (FM); Goose Valley, Shasta Co., June 29, July 11, 1912, *Eastwood 770* (GH; herbage of subsp. *glauca* and inflorescence of subsp. *pallida*); Greenhorn Pass, 5000–6000 ft., Apr., Sept. 1897, *Purpus 5532* (US); Truckee, 1750 m., July 14, 1913, *Hitchcock 316* (US); Pine Ridge, Fresno Co., 5200 ft., June 15–25, 1900, *Hall & Chandler 286* (MBG; US; suggests subsp. *pinetorum* somewhat); Rancheria Mt., north of Tuolumne R., 8500 ft., July 24, 1909, *Jepson 3404a* (J); South Yallo Bolley, July 2, 1897, *Jepson 100i* (J; "flowers nearly white—merely lilac-tinged"); Mt. Shasta, near snow line, Aug. 4, 1894, *Jepson 59f* (J.); Kennedy's meadow, Tuolumne Co., 6700 ft., Aug. 4, 1916, *Grant 896* (J; herbage of subsp. *glauca* and inflorescence of subsp. *pallida*); Huntington Lake, Fresno Co., 7000 ft., July 20, 1917, *Grant* (J); Campito Mt., White Mts., 10,700 ft., July 25, 1917, *Jepson 7286* (J).

Nevada: Galena Creek, Mt. Rose, Washoe Co., 8000 ft., Aug., 1906, *Kennedy 1236* (US). The following have the inflorescence of subsp. *pallida*, or approach it more closely, but in herbage suggest subsp. *glauca:* Mt. Rose, Washoe Co., 9700 ft., Aug. 26, 1911, *Heller 10345* (GH; MBG; US); Clear Creek Canyon, Ormsby Co., 2000–2615 m., July 22, 1902, *Baker 1347* (MBG; GH; US).

Oregon: Keno, Klamath Co., July 9, 1920, *Peck 9413* (MBG); Mt. Pitt (Jackson-Klamath Co.), Aug. 16, 1896, *Gorman 457* (US); Gayhart Buttes, 2100 m., Aug. 7, 1896, *Coville & Leiberg 266* (US).

e. Subsp. **pinetorum** (Heller), comb. nov.

Monardella pinetorum Heller, Muhlenbergia **1:** 36. 1904.

Madronella pinetorum Heller, Muhlenbergia **1:** 138. 1906.

Branches softly pubescent, not glaucous-appearing, leaves ovate to lanceolate, 1.5–2.5 cm. long, somewhat rounded at the base, tapering to a usually *margined petiole* 2–8 mm. long, the upper seldom appearing sessile, *softly pubescent*, even to subvillous principally *on the under surface*, the margin usually revolute and obscurely crenate-dentate or entire; bracts inconspicuous but erect, equaling the calyces, ovate, *short-pubescent*, purplish, ciliate; calyx pubescent, the hairs spreading and not curling; corolla 1.0–1.5 cm. long, rose-color, the lobes noticeably tapering, the tube exserted 1–2 mm.

Specimens examined:

California: southern slope of Mt. Sanhedrin above the sawmill, July 19, 1902, *Heller 5909* (MBG; GH; US); near Slap Jack

Camp, west of alder springs, 5000 ft., Glenn Co., July 5, 1917, *Heller 12810* (OAC; US; MBG; GH; *type collection* of *M. pinetorum* Heller); south fork Kaweah River, Tulare Co., July 22, 1904, *Culbertson 4477* (GH; MBG); McCombers, Aug. 1, *Newberry* (US); Longworthys, near North Fork, 4500 ft., July 16, 1912, *Abrams 4951* (GH; DH; suggests *M. villosa*).

This group strongly suggests hybridization with *M. villosa.*

f. Subsp. **parvifolia** (Greene), comb. nov.

Monardella parvifolia Greene, Pl. Baker. **3**: 22. 1901.

Monardella muriculata Greene, Pittonia **5**: 84. 1902.

Madronella parvifolia Rydb. Bull. Torr. Bot. Club **33**: 150. 1906.

Madronella muriculata Greene, Leaflets Bot. Obs. **1**: 169. 1906.

Monardella parviflora Nelson in Coulter & Nelson, Manual Central Rocky Mts. 430. 1909 (not Greene; in error for *M. parvifolia* Greene).

Branches *scurfy-pubescent, cinereous, slender,* seldom puberulent and purplish; leaves lanceolate or oblong, *1–2 cm. long,* tapering at the base to a margined petiole 1–3 mm. long, *cinereous,* but not glaucous-appearing, with a sparse, short pubescence; glomerules small for the species, *1–2 cm. broad, bracts inconspicuous,* seldom exceeding the calyces, ovate, acute, or shortly acuminate, pubescent, even shortly villous, ciliate; calyx 5–6 mm. long, *pubescent, sparingly villous around the teeth;* corolla seldom exceeding a centimeter in length.

Specimens examined:

California: foot of Mt. Whitney, 12,000 ft., Sept. (in flower), 1875, *Rothrock 42* (US; GH); near Whitney Meadows, Aug. 20, 1891, *Coville & Funston 1646* (US); along Big Cottonwood Creek (Inyo Co.), Aug. 4, 1891, *Koch 2158* (US); Ebbets Pass, on dry mountain top, 8500–9000 ft., Aug. 1, 1863, *Brewer 2006* (US); Tuolumne Meadows, dry ledges, 8600 ft., July 20, 1907, *Ware 2658* (GH); Mammoth Lakes just below Mary's Lake, 8900 ft., "In small openings in the subalpine forests of *Abies magnifica* and *Pinus monticola,* with *Chrysopsis Breweri, Ceanothus velutinus, Gilia aggregata* and *Haplopappus Bloomeri,*" Aug. 30, 1923, *Hall 11893* (UC); Junction Camp to Whitney, head of Kern Canyon, 9500 ft., Aug. 1–12, 1900, *Jepson 1055* (J).

NEVADA: Morey Peak, 7000–8000 ft., May–Oct. 1898, *Purpus 6369* (US); Star Peak, 8500 ft., Sept. 1867, *Watson 826* (US; a second collection bearing the same collection number was made from E. Humboldt Range, 8000 ft., Aug. 1868; both are similar and are the plants referred to by Watson in the Botany of the King's Expedition). The plant described by Greene as *M. muriculata* was from the same locality and the plant of Watson from Star Peak resembles Greene's type closely.

ARIZONA: near Sunset Peak, 6000 ft., July 13, 1901, *Leiberg 5698* (US); Flagstaff, May–Oct. 1900, *Purpus 8089* (US; MBG); San Francisco Mts., crater at 10,000 ft., July 16, 1913, *Goldman 2132* (US); Schulze's Ranch, 8000 ft., San Francisco Mts., July 7, 1891, *MacDougal 404* (US; suggests subsp. *euodoratissima*); San Francisco Mts., 9000 ft., Aug. 3, 1898, *MacDougal 363* (GH; RMH; US); hillsides along the northern foot of San Francisco Mts., 5550 ft., July 1, 1901, *Leiberg 5620* (US; suggests subsp. *glauca*); northern slopes of San Francisco Mts., 5500 ft., Aug. 29, 1901, *Leiberg 5906* (US); near Kendrick Mts., 6600 ft., July 7, 1901, *Leiberg 5653* (US).

COLORADO: Black Canyon near Sapinero, 7200 ft., Sept. 1893, *Purpus 726* (FM); Black Canyon, 7000 ft., Aug. 1, 1901, *Baker 678* (RMH; US; GH; MBG; *type collection* of *M. parvifolia* Greene); Placerville, June 23, 1917, *Payson 1097* (MBG); Black Canyon, July 30, 1917, *Bethel* (CSM); El Late (Ute) Mts., Aug. 1875, *Brandegee 1224* (MBG).

NEW MEXICO: near Mogollon, Mogollon Mts., Socorro Co., Aug. 8, 1900, *Wooton* (US; RMH).

g. Subsp. **australis** (Abrams), comb. nov.

Monardella australis Abrams, Muhlenbergia 8: 34. 1912; Davidson & Moxley, Fl. South. Calif. 313. 1923.

Branches *decumbent or ascending*, seldom erect, sparsely pubescent, *subvillous;* leaves lanceolate or oblong, often acute, green or cinereous, but not glaucous-like or silvery, 1–2.5 cm. long, narrowed at the base to a petiole 1–3 mm. long; bracts lanceolate, *exceeding the calyces, short-acuminate*, whitish or purple, puberulent, frequently with a sparse pubescence in addition, the margin ciliate, but not strongly; corolla about 1.5 cm. long, the lobes slender, tapering, but not greatly.

Specimens examined:

CALIFORNIA: San Bernardino Mts., 1880, *Nevin* (GH); San Jacinto Mt., 8000–10,000 ft. (6000–10,000 ft. on some sheets), July 22, 1917, *Hall 713* (UC; DH; US); on trail to summit of Round Valley, 9300 ft., July 11, 1908, *Reed 2420* (US); in open forests of Tamarack Valley, 9200 ft., July, 1901, *Hall 2486* (UC; BH; MBG; *type collection* of *M. australis* Abrams, TYPE in DH); San Bernardino Mts., Aug. 1884, *S. B. & W. F. Parish 462* (MBG); High Creek, San Bernardino Mts., 9100 ft., Aug. 23, 1923, *Munz 7629* (BH); north side of Mt. Waterman, Aug. 29, 1917, *Grinnell* (BH); Tahquitz Valley (San Jacinto Mts.), no data (BH); Box Springs on City Creek Road, 4800 ft., June 8, 1919, *Johnston 2894* (BH); slope above Tamarack Valley, 10,000 ft., Sept. 7, 1922, *Munz 6409* (BH); Little Bear Valley, 5300 ft., July, 1899, *Hall 1298* (UC); San Jacinto Mt., Aug. 1881, *S. B. & W. F. Parish 462* (GH; MBG; FM; the latter is dated July, 1881, from San Bernardino Mts., but bears the same number); Mt. Grayback, San Bernardino Mts., June, 1880, *Wright* (GH); Tahquitz Creek above Walters, San Jacinto Mts., July 10, 1909, *Wilder 2 & 3* (UC); Deep Creek, San Bernardino Mts., July 30, 1901, *Abrams 2046* (DH); Little Bear Valley, 5000 ft., July 22, 1897, *Chandler* (UC); Mill Creek Divide, San Bernardino Mts., 8000 ft., *Robertson 107* (UC); Tahquitz Valley, San Jacinto Mts., July 10, 1909, *Wilder 1* (UC); slope of San Jacinto Creek, 10,300 ft., *Jepson 2314* (J); Tahquitz Valley, San Jacinto Mt., 8000 ft., *Jepson 2295* (J).

Some forms suggest *M. macrantha* var. *tenuiflora* but differ in the flower.

11. M. linoides Gray, Proc. Am. Acad. **11**: 101. 1876; Bot. Calif. **1**: 594. 1876; Syn. Fl. N. Am., ed. 2, 2^1: 357. 1886.

Perennial from a woody, usually decumbent, branching stem, the bark light brown, checking and falling away; branches erect, their arrangement often candelabra-like, rebranching below, if at all, 30–50 cm. tall, *pubescence minute, close, silvery;* leaves *narrowly oblong, oblong, or narrowly lanceolate,* 1–4 cm. long, acute or obtuse, entire, narrowed to a petiole 2–4 mm. long, the uppermost appearing sessile, the *lowermost obovate or spatulate,* all covered with a minute *silvery* pubescence; glomerules 2–3 cm. broad, bracts ovate to lanceolate, acuminate, equalling or exceeding the calyces, scarious-membranous, whitish puberulent or tinged with rose to purple, the margin subciliate; calyx 6–10 mm. long, 13-nerved, even throughout and rather slender, closely puberulent to rather sparingly hirsute, especially above, teeth slender, hirsute within; corolla 12–15 mm. long, rose-purple or pallid, the lobes slender, tending to oblong rather than lanceolate, blunt, tube retrorsely puberulent within and without, the lips subequal, the lobes of the upper about one-half its length, those of the lower lip nearly or quite free, filaments retrorsely hispidulous towards the base, but variable, anther-sacs divergent, the connective equilateral, well developed.

Key to the Subspecies

A. Bracts ovate to rotund, whitish........................subsp. *eulinoides*
B. Bracts lanceolate, purple-colored........................subsp. *stricta*

a. Subsp. **eulinoides,** nom. nov.

Monardella linoides Abrams, Muhlenbergia **8:** 37. 1912; Davidson & Moxley, Fl. South. Calif. 313. 1923.

M. viminea Greene, Pittonia **5:** 85. 1902; Abrams, Muhlenbergia **8:** 37. 1912; Davidson & Moxley, Fl. South. Calif. 313. 1923.

M. oblonga Greene, Pittonia **5:** 83. 1902; Abrams, Muhlenbergia **8:** 38. 1912; Davidson & Moxley, Fl. South. Calif. 313. 1923.

M. anemonoides Greene, Pittonia **5:** 86. 1902.

Madronella linoides Greene, Leaflets Bot. Obs. **1:** 169. 1906.

Madronella viminea Greene, Leaflets Bot. Obs. **1:** 169. 1906.

Madronella oblonga Greene, Leaflets Bot. Obs. **1:** 169. 1906.

Madronella anemonoides Greene, Leaflets Bot. Obs. **1:** 169. 1906.

Herbage silvery, with a close minute puberulence, the leaves narrowly oblong or narrowly lanceolate; bracts *broadly ovate, shortly acuminate, whitish puberulent,* infrequently tinged with purple, occasionally pubescent, surpassing the calyces, *not infrequently enveloping them; calyx puberulent* or sparingly hispid;

lobes of the corolla tending to narrowly oblong, tapering but little, the upper lip usually incised to about one-half its length.

Specimens examined:

CALIFORNIA: Oriflamme Mine, near San Diego, July 28, 1875, *E. Palmer 261* (*?296*) (GH, TYPE; MBG; UC); Oriflamme Canyon near Cuyamaca, June 28, 1903, *Abrams 3932* (US; GH; MBG; BH); Tahquitz Valley, San Jacinto Mts., 7000 ft., June-July, 1901, *Hall 2430* (US; UC; MBG); 20 mi. south of Palm Springs, July 30, 1897, *Hall 758* (UC); Coyote Canyon, Santa Rosa Mts., 5000 ft., June, 1901, *Hall 2137* (UC); eastern base of San Jacinto Mts., June, 1901, *Hall 2110* (UC); Santa Rosa Mts., Santa Rosa, 6500 ft., June 30, 1922, *Munz 5921* (UC; BH); Big Morongo Canyon, San Bernardino Mts., 3000 ft., June 15, 1894, *S. B. Parish 3009* (US; MBG); San Diego Co., 1889, *Orcutt* (US); Laguna Mts., July, 1889, *Orcutt* (US). The following illustrate the form described as *M. viminea:* McCoon's Ranch near Poway, 400–500 ft., June 8–9, 1897, *S. B. Parish 4421* (MBG; GH; US); near San Diego, 1880, *Vasey 491* (US, TYPE of *M. viminea* Greene); San Diego, May, 1906, *T. S. Brandegee* (FM); San Diego, May 21, 1894, *Brandegee* (UC); "along river bed," San Diego Co., ?1878, *Cleveland* (GH). The following illustrate the form known as *M. anemonoides:* Greenhorn Mts., 6000–7000 ft., Kern Co., June 7–15, 1888, *E. Palmer 69* (MBG; US, *type collection* of *M. anemonoides* Greene, TYPE in US); Pah Ute Peak, 5000–6000 ft., June, 1897, *Purpus 5096* (UC; US; GH; MBG); Argus Peak, Kern Co., 5000–6000 ft., June, 1897, *Purpus 5098* (US; UC; GH; MBG); Cottonwood Cr., 7000–7500 ft., Inyo Co., Aug. 1896, *Purpus 1947* (UC); road between Bishop & Andrews Camp, Inyo Co., July, 1913, *K. Brandegee* (UC); Panamint Mts., Wild Rose Canyon, June 24, 1891, *Coville & Funston 2045* (US); Westgard Pass, between Deep Springs Valley and Big Pine, Inyo Co., July 19, 1918, *Ferris 1381* (DH). The following illustrate the form known as *M. oblonga* Greene: Mt. Pinos, 6500 ft., July 7, 1904, *Grinnell* (UC, a good match for the type of *M. oblonga* Greene); Tehachapi Mts., vicinity of Bisses station (?Bissel), June 28, 1895, *Dudley 476* (DH; US; UC); Griffin's, Ventura Co., July, 1902, *Elmer 3952* (GH; US); Frazier Mt., 6000 ft., June 15, 1896, *Dudley & Lamb* (DH; BH); Mt. Pinos, Ventura Co., North Fork, 6000 ft., June 28, 1905, *Hall 6461* (UC); Kaiser Crest, Fresno Co., 9700 ft., July 28, 1914, *Smiley 646* (GH).

LOWER CALIFORNIA: Palm Valley, June 3, 1883, *Orcutt 382* (MBG; GH); San Pedro Martir, 7000 ft., May 6, 1893, *T. S. Brandegee* (UC); "Mountains of the Peninsula," July 25, 1885, *Orcutt* (UC); Cantites (?) Mts., July 26, 1883, *Orcutt 927* (GH); mountains of Lower Calif., July 25, 1883, *Orcutt* (FM).

b. Subsp. **stricta** (Parish), comb. nov.

Monardella linoides stricta Parish, Erythea **7:** 96, 1899.

M. epilobioides Greene, Pittonia **5:** 85. 1902; Abrams, Muhlenbergia **8:** 35. 1912; Davidson & Moxley, Fl. South. Calif. 313. 1923.

M. epilobioides var. *erecta* Abrams, Muhlenbergia **8:** 36. 1912; Davidson & Moxley, Fl. South. Calif. 313. 1923.

Madronella epilobioides Greene, Leaflets Bot. Obs. **1:** 196. 1906.

Herbage similar to that of subsp. *typica* but tending in some to have a short sparse pubescence in addition to the silvery covering; bracts *lanceolate, distinctly short-acuminate, whitish, tinged with rose, to a deep purple*, puberulent or sparingly pubescent, the margin subciliate; calyx puberulent to *sparsely hispid;* the lobes of the corolla tending to lanceolate rather than oblong, the upper lip more often cut to less than half its length.

Specimens examined:

CALIFORNIA: The following illustrate the form known as *M. epilobioides* Greene: San Antonio Mts., July, 1896, *Hall* (RMH; BH; US); 12 mi. west of Cajon Pass, Aug. 6, 1896, *Hall 297* (US; UC); the two preceding suggest *M. viminea;* San Bernardino Mts., Aug. 1884, *S. B. Parish 2077* (UC; TYPE of *M. linoides* var. *stricta* Parish); Le Montaine, north of Big Pines, 7300 ft., July 5, 1922, "very abundant on open slopes but hardly in bloom at this time" *Peirson 3160* (J); San Bernardino Mts., Aug. 1881, *S. B. & W. F. Parish 462a* (GH, suggests *M. viminea*); Mill Creek Canyon, 1904, *Smith 105* (UC); Bear Valley, San Bernardino Mts., 6500 ft., June 22, 1894, *S. B. Parish 3008* (UC; MBG; US; *type collection* of *M. epilobioides* Greene, TYPE in US); Little Green Valley, San Bernardino Mts., 7200 ft., July, 1904, *Hall 2* (UC). The following illustrate the form known as *M. epilobioides* var.

erecta Abrams: Mt. San Gorgonio, 7500 ft., July 23, 1904, *Grant 795a* (FM; MBG; UC); Santa Ana R., San Bernardino Mts., 6100 ft., July 27, 1906, *J. & H. W. Grinnell 306* (US); Upper Santa Ana Canyon, 8500 ft., July 26, 1906, *Hall 7578* (RMH; US; BH; MBG; UC); Fish Creek, San Bernardino Mts., 8700 ft., Sept. 1, 1921, *Jaeger* (BH); above Green Valley, July, 1899, *Hall 1362* (UC); on dry ridges, Bear Valley, Aug. 3, 1902, *Abrams 2861* (GH; MBG; UC; BH; US, *type collection* of *M. epilobioides* var. *erecta* Abrams, TYPE in DH); east of Fish Camp, San Bernardino Mts., 6700 ft., July 17, 1921, *Johnston 2898* (BH, suggests *M. australis* Abrams); San Bernardino Mts., 7000 ft., July 19, 1898, *Hall 1021* (UC); South Fork Meadows, Santa Ana Canyon, 8200 ft., Aug. 6, 1906, *Hall 7676* (UC).

NEVADA: Lee Canyon, Charleston Mts., Clark Co., 8000 ft., July 25, 1913, *Heller 10984* (US; MBG; GH).

ARIZONA: Little Meadows, June 28, 1902, *Stephens* (UC).

LOWER CALIFORNIA: Hansens, Sept. 18, 1884, *Orcutt 1224* (GH); San Pedro Martir, 7000 ft., May 6, 1893, *T. S. Brandegee* (UC); San Pedro Martir, Aug. 1903, *Robertson 54* (UC); Oallecitos, San Pedro Martir Mts., 8000 ft., July 15, 1905, *Goldman 1240* (US).

After a careful study of a considerable mass of herbarium material, representing *M. linoides* from most of the localities where it is known to grow, the opinion has been formed that some, at least, of the numerous forms have been caused by hybridization. Whether this is true remains to be determined. In the San Bernardino Mountains, especially, the data are very confusing. One may pass by imperceptible gradations from the form originally described by Dr. Gray as *M. linoides* to the plant of the interior mountains described herein as *M. odoratissima* subsp. *glauca.* In a similar way he may pass into *M. odoratissima* subsp. *australis* or into the group described as subsp. *stricta.* Until some evidence is forthcoming as to the nature of these variants, whether partly or wholly environmental, whether hybrid, due to the existence of several closely related subspecies, or both, it seems desirable to retain the present arrangement which will permit of fairly close determination of material. Furthermore, the two groups as thus outlined have a distribution which seems fairly consistent.

M. viminea Greene is a plant in which the stems are unusually long, with long internodes, the leaves similarly elongate and glabrate, and the calyx and bracts pubescent. In shape and size the bracts are midway between subsp. *eulinoides* and subsp. *stricta*. As it is found on the type sheet, the several stems have been coiled, in order to gain space, the whole suggesting the willowy aspect from which the name was derived. Few collections may be referred to this, and the author has seen no plants as extreme as the plant of the type sheet.

Only a photograph of the type sheet of *M. oblonga* Greene has been available for study. However, the collection of Grinnell on Mt. Pinos (UC, 149541) is a very good match for both the description and photograph; the type was collected "in the mountains south of Tehachapi," June 24, 1889, by Greene and is at Notre Dame. In general, the more hairy calyx and broader leaf characterize the plants of the more northern stations.

M. anemonoides Greene is an extreme form in which the bracts are unusually developed in such a way as to envelop and conceal the flowers. The bracts of the plant collected at the same time and deposited at the Missouri Botanical Garden (the type is in the U. S. National Herbarium) are not greatly above normal, and apart from this collection the author has seen nothing to equal the type sheet.

M. linoides subsp. *stricta* may, in a general way, be divided into two forms, namely, one (*M. epilobioides* Greene) with but two or three slender, erect, fertile branches (suggestive of *M. viminea* Greene) which arise from a low tuft of sterile branches, with elliptic-oblong leaves, and a second form (*M. epilobioides* var. *erecta* Abrams) in which the fertile branches are numerous, subequal, and more or less fastigiate, with leaves shorter and linear-oblong.

§ SECTION IV. ANNUAE

12. M. undulata Benth. Lab. Gen. et Sp. 332. 1834; in DC. Prodr. **12:** 190. 1848; Gray, Proc. Am. Acad. **11:** 102. 1876; Bot. Calif. **1:** 594. 1876; Syn. Fl. N. Am., ed. 2, **2**[1]**:** 358. 1886; Jepson, Fl. West. Middle Calif., ed. 2, 363. 1911.

Madronella undulata Greene, Leaflets Bot. Obs. **1:** 168. 1906.

Annual or perennial, usually forming a *bush-like plant* 20–40 cm. tall, or erect, rather slender, the ascending branches unbranched, branches purple, puberulent; leaves somewhat *succulent, oblanceolate-oblong*, 2–5 cm. long, obtuse, glabrate, thinly villous, or shortly pubescent, the margins undulate or crisped, narrowed to a short petiole; glomerules compact, 2.5–3.5 cm. broad, bracts broadly ovate or orbicular to elliptical, obtuse or acute, variable in size, equal to the calyces or much exceeding the flowers, submembranous with green or purple prominent parallel veins, or scarious, glabrate to villous; calyx 5–9 mm. long, variable on the same plant, 13–15-veined, tapering downwards, subglabrous and subscarious below, green or purplish and villous above, or villous throughout, the teeth ovate-triangular, obtuse, hairy, white within; corolla rose-purple, 14–20 mm. long, the tube twice the length of the corolla or less, the *throat ample and hairy within*, the upper lip somewhat shorter, the lobes coalesced two-thirds its length or more, those of the lower coalesced one-third to one-fourth its length, linear-oblong or tapering; anthers divergent, the connective equilateral, well developed.

California: Gigling, Monterey Co., June 1903, *Elmer 4379* (OAC); along the railroad 2 mi. northeast of Del Monte, Monterey Co., July 31, 1906, *Heller 8426* (GH; US; MBG); Point Reyes, Marin Co., July, 1903, *Elmer 4611* (MBG; US); Point Reyes, May 5, 1901, *Eastwood* (GH); Point Reyes, June 23, 1915, *Eastwood 4773* (GH); San Francisco, 1865, *Bolander* (MBG; GH); San Francisco, near Lake Merced, August 5, 1913, *Suksdorf 786* (GH); "California," *Hartweg* (GH); Bardins, June, 1903, *Elmer 4379* (US; MBG); "Northern California," *D. Douglas* (GH; a portion of the *type collection* cited by Bentham); Lake Merced near San Francisco, June, 1905, *K. Brandegee* (RMH); Clarke Creek, 10 mi. from San Luis Obispo, June 26, 1876, *E. Palmer 362* (GH; MBG; US); Arroyo Grande, San Luis Obispo Co., June, 1887, *Lemmon 4622* (GH); sea-shore hills, Feb. 3, 1882, *Summers* (MBG; US); Nipomo, San Luis Obispo Co., sandbanks, *Bolander* (GH); Nipomo, San Luis Obispo Co., Apr. 11, 1861, *Brewer 421* (US); Castroville, Monterey Co., *K. Brandegee* (US).

Var. **crispa** (Elmer), comb. nov.

Monardella crispa Elmer, Bot. Gaz. **39**: 46. 1905.

A *low shrubby plant* 20–30 cm. tall, bush-like in appearance, the branches simple or branching, *lanately villous*, the older parts covered with a light brown checking bark; leaves oblanceolate-oblong, 2–5 cm. long, as much as 1 cm. broad, very blunt at the apex, rather succulent, pubescent, undulate or crisped, narrowed into a short petiole; bracts ovate or roundish, villous; calyx 6–8 mm. long; corolla 12–14 mm. long, the lobes tapering and tending to lanceolate rather than oblong.

Specimens examined:

CALIFORNIA: Surf, Santa Barbara Co., May, 1902, *Elmer 3965* (MBG; US; *type collection* of *M. crispa* Elmer, TYPE in DH); Santa Maria, Santa Barbara Co., 1882, *Jared* (GH); Surf, Santa Barbara Co., "on beaches but most abundant on the hills," May, 1909, *K. Brandegee* (UC; GH; US); no locality stated, *Coulter 536* (GH; cited by Bentham); San Luis Obispo, *Summers* (GH); Point Reyes, May, 1906, *Eastwood* (US); Casmalia, Santa Barbara Co., *Eastwood* (US).

13. **M. Douglasii** Benth. Lab. Gen. et Sp. 332. 1834; in DC. Prodr. **12**: 190. 1848; Gray, Proc. Am. Acad. **11**: 102. 1876; Bot. Calif. **1**: 595. 1876; Syn. Fl. N. Am., ed. 2, 2^1: 357. 1886; Jepson, Fl. West. Middle Calif., ed. 2, 363. 1911.

Monardella candicans var. *venosa* Torrey, Pacif. R. R. Rept. **4**: 123. 1857 (Whipple's Exp.).

Madronella Douglasii Greene, Leaflets Bot. Obs. **1**: 168. 1906.

Annual, erect, with divaricate branches, 20–30 cm. tall, or often simple, with a single terminal inflorescence; stems purplish, puberulent; leaves 1–3 cm. long, lanceolate to linear-oblong, puberulent, narrowed at the base to a petiole 1–5 mm. long; glomerules 1.5–3 cm. broad; bracts ovate-lanceolate, surpassing the calyces, *with a strong midrib and a well-defined marginal vein formed by the confluence of the ascending lateral veins, the intravenous tissue like isinglass when dry, transparent, the veins purple, rough-pubescent, margin ciliate;* calyx 7–9 mm. long, 15-nerved, pubescent or hirsute, the teeth rigid, acute, subcuspidate, pubescent within; corolla deep reddish purple, 11–12 mm. long, the tube somewhat exserted, retrorsely puberulent, lips subequal, the lobes of the upper coalesced more than half its length, those of the lower nearly free, slender, tapering slightly; the anther-sacs subparallel, confluent behind, the connective scarcely wider than the filament.

Specimens examined:

CALIFORNIA: Moragua Valley (Bay Region), Aug. 1863, *Bolander 2499* (GH; UC; US); plains of the Feather River near Marysville, May 25, 1854, *Bigelow* (Whipple's Exp.) (GH; US; *type collection* of *M. candicans* var. *venosa* Torrey); Oakland, May 29, 1892, *Brandegee* (GH); Gilroy, June 16, 1896, *Jepson* (US; MBG; J); Mt. Diablo, July, 1903, *Elmer 4544* (MBG); Plumas Co., *Austin* (MBG); Oakland Hills, 1865, *Bolander* (GH; MBG); near San Francisco, *Kellogg* (GH); Mt. Hamilton, July, 1905, *R. I. Smith* (RMH); Cherokee, Butte Co., May, 1879, *Bidwell* (GH); Alameda, 1876, *Vasey* (GH); Butte Co., 1882, *Parry* (UC); Chico Valley, May, 1882, *Parry* (UC); Black Canyon (? Marin Co.), July, 1885, *K. Brandegee* (UC); San Jose, May 20, 1897, *Chipman* (US); locality not given, 1875, *Vasey* (US).

14. M. lanceolata Gray, Proc. Am. Acad. **11**: 102. 1876; Bot. Calif. **1**: 594. 1876; Syn. Fl. N. Am., ed. 2, **2**[1]: 357. 1886; Hall, Univ. Calif. Publ. Bot. **1**: 108. 1902; Jepson, Fl. West. Middle Calif., ed. 2, 363. 1911; Abrams, Muhlenbergia **8**: 41. 1912; Fl. Los Angeles, ed. 2, 318. 1917; Davidson & Moxley, Fl. South. Calif. 314. 1923.

Monardella sanguinea Greene, Pittonia **5**: 86. 1902.

M. acuta Greene, in Herb. Baker. 1193. 1902.

Madronella sanguinea Greene, Leaflets Bot. Obs. **1**: 169. 1906.

Madronella lanceolata Greene, Leaflets Bot. Obs. **1**: 169. 1906.

Annual, erect, 30–50 cm. tall, branching throughout, but with a tendency to branch chiefly in the upper axils, the branches divaricate but curving upwards, puberulent, purplish; leaves lanceolate, 3–4 cm. long, obtuse, entire, sparsely puberulent, narrowed to a slender petiole 0.5–1.5 cm. long; glomerules 1.5–3 cm. broad, *bracts ovate-lanceolate, acute,* surpassing the calyces, scabrous, membranous but *green, pinnately veined with numerous readily observed net-like secondary veins, the principal veins prominent, often costate;* calyx 6–8 mm. long, glabrous or scabrous, sometimes bristly at the sinuses, veins slender, typically 13, teeth ovate-triangular, acute, hirsute within; corolla rose-purple, 12–15 mm.

long, the tube somewhat exserted, puberulent, the limb 3–5 mm. long, the upper lip shorter, lanceolate in outline, the lobes coalesced one-half its length or more, those of the lower lip free nearly or quite to the base, tapering slightly; anther-sacs divergent at an angle of about 60°, the connective about as wide as the filament, little developed and scarcely evident from behind; nutlets oblong-oval, about 2 mm. long.

Specimens examined:

California: Tallac, Lake Tahoe, 6300 ft., July 18, 1913, *Smiley 132* (GH); Tioga road above Aspen Valley, 6500 ft., Aug. 24, 1916, *Smiley* (GH); Yosemite Valley, Sept.–Oct. 1878, *Phillips & Sargent* (GH); Glendora, July 7, 1902, *Abrams 2662* (GH; MBG); Cuyamaca, 4000 ft., June 30, 1917, *Spencer 635* (GH); Cajon Pass, June 8, 1861, *Cooper* (GH; US); Shasta Co., between the McCloud and Sacramento Rivers, July 23, 1916, *Heller 12499* (GH; MBG); Oakgrove Canyon, Liebre Mts., 3500–4000 ft., July 19–21, 1908, *Abrams & McGregor 350* (GH); Bloomington, June 2, 1917, *S. B. Parish 11268* (GH; BH; MBG); Colton, April, 1885, *S. B. Parish 1750* (GH); locality and date not given, *Bridges 308* (GH); Fort Tejon, 1857–58, *de Vasey 77* (GH); south fork, Kaweah River, Tulare Co., July 20, 1904, *Culbertson* (Baker 4489) (GH; MBG); Nevada City, July 14, 1905, *Heller 8114* (GH); no locality given, 1872, *Gray* (GH); San Diego, 1875, *Cleveland* (GH; some of these approach var. *microcephala*); Ramona Valley, San Diego Co., June 19, 1903, *Abrams 3773* (GH; MBG); Yosemite Valley, July, 1866, *Bolander 6320* (GH; US); Calaveras Co., 1877, *Hooker & Gray* (GH); foothills of the Sierra Nevada, 1865, *Torrey* (GH); Ojai Valley, July, 1875, *Rothrock 175* (GH); Snowdon Ranch, Calaveras Co., July–Aug., 1890, *Jepson 50f* (J); Hetch-Hetchy, "opens" on valley floor, *Jepson 3437* (J); Augustine's ranch, Palômar, May 30, 1901, *Jepson 1549* (J); Mineral King road, 5900 ft., Aug. 1–12, 1900, *Jepson 1160* (J); Colton, June, 1882, *S. B. & W. F. Parish 1430* (GH); southern California, 1876, *Parry & Lemmon 331* (GH; MBG); Tulare Mts., May, 1878, *Lemmon 336* (GH); Middle Tule River, 3000–4000 ft., April–Sept. 1897, *Purpus 5040* (GH; MBG); Middle Tule River, 4000–5000 ft., April–Sept. 1897, *Purpus 5050* (GH; MBG); Newcastle Road, Plumas Co., May, 1894, *Ames*

(GH); Yosemite Valley, June 28, 1911, 4000–5000 ft., *Abrams 4562* (GH); Pitt to Baird, Shasta Co., July 25, 1912, *Eastwood 1439* (GH; MBG); West Point Bridge, 2300 ft., July 7, 1896, *Hansen 1824* (MBG); Mariposa, June 14, 1903, *Congdon* (MBG); Nevada Co., July 14, 1905, *Heller 8114* (MBG); Ranger Station, Amador Co., 2000 ft., June, 1891, *Hansen 128* (MBG); mountains above Claremont, no date, *Davis* (MBG); Mojave River, June 1, 1876, *E. Palmer 363* (MBG); Sierra Santa Monica, June, 1889, *Hasse* (MBG); Mt. Lowe, Los Angeles Co., 1903, *Grant 796a* (MBG); Strawberry Valley, San Jacinto Mts., 6000 ft., Aug. 28, 1896, *Hall 340* (MBG); southern California, near the boundary, June, 1880, *S. B. Parish* (MBG); San Bernardino Mts., 3000 ft., June 29, 1888, *S. B. Parish* (MBG; it is probably this collection which was referred by Greene to *M. sanguinea*); Tigh's ranch, San Diego Co., July 4, 1875, *E. Palmer 294* (MBG); North Fork and vicinity, May 30–June 8, 1903, *Griffiths 4628* (MBG); Madera, July 10, 1904, *Griffiths 6589* (MBG); Tehachapi Peak, June 28, 1895, *Dudley 348* (OAC); Nevada (?City), no date, *Pratten* (MBG); La Crescenta, 1897, *Wislizenus 1307* (MBG); Dry Canyon, July 15, 1917, *Johnston 1912* (BH); Palomar, July, 1901, *Schellenger* (BH); Strawberry Valley, San Jacinto Mts., 5200–6000 ft., July, 1901, *Hall 2527* (BH); Santa Ana River, San Bernardino Mts., 6300 ft., Aug. 21, 1922, *Munz 6149* (BH); Little Chico Cr., 2000 ft., July 5, 1900, *Leiberg 5022* (US); Deer Cr. Canyon, Tehama Co., July 17, 1911, *Eggleston 7277* (US); Breckinridge Range, Kern Co., 5000 ft., 1905, *Hopkins* (US); between Temecula and Pala, July 10, 1915, *Collins & Kempton 224* (US); San Jacinto Plains, 1880, *Vasey 490* (US); Tehachapi Pass, Kern Co., June 25, 1891, *Coville & Funston 1113* (US); Lyttle Cr., San Gabriel Reserve, 1800 m., April 29, 1898, *Leiberg 3364* (US); Tejunga Wash, Los Angeles Co., July 6, 1905, *Grinnell* (US); Yosemite Valley, Aug. 17, 1872, *Redfield 6497* (MBG); Yosemite Valley, 1886, *Bolander 6320* (MBG); Forest Ranch, Butte Co., July 24, 1914, *Heller 11628* (GH; OAC; US); Azusa, June 22, 1915, *Macbride & Payson 731* (GH); Plumas Co., *Ames* (GH); San Bernardino Mts., *S. B. & W. F. Parish 405* (MBG); Palomar Mt., San Diego Co., Sept. 14, 1922, *Spencer 635* (BH); Etiwanda, June 16, 1921, 1500 ft., *Munz 4658* (BH); San Dimas Canyon, July 4, 1915, *Davis* (BH); San Jacinto, 6000 ft., July 15, 1898, *Anthony* (UC); Little Bear Valley, San Bernardino Mts., 5000 ft., July 31, 1897, *Chandler* (UC); head of Hemet Valley, 5000 ft., July 3, 1922, *Munz* (UC); Julian, Aug. 4, 1892, *Dunn* (UC); Downieville, Sierra Co., 1909, *Kennedy 29* (UC); El Dorado Co., Aug. 1914, *K. Brandegee* (UC); Rennies Sta., 3000 ft., June 27, 1897, *Reed* (BH); San Joaquin Hills, Orange Co., July 13, 1901, *Abrams 1788* (BH); Fort Tejon, June, 1881, *S. B. Parish* (J); Fish Cañon, San Gabriel Mts., 1000 ft., July 1, 1919, *Peirson 511* (J).

Nevada: Lake Tahoe, 6300 ft., Washoe Co., Aug. 8, 1906, *Kennedy 1459* (MBG); Kings Canyon, Ormsby Co., 1700–2000 m., June 30, 1902, *Baker 1193* (GH; MBG; US); western Douglas Co., 6250 ft., *Hall & Chandler 4593* (UC; US).

Arizona: Mont Cr. (northern Ariz.), Aug. 9, 1894, *Wilson* (UC, as "*M. lanceolata Arizonica*").

As it occurs in the southern part of its range, *M. lanceolata* tends to become more slender, lower in height, with fewer branches, these being in the upper axils and divaricate. The glomerules are often reduced in size and the corollas are a deeper color. It was such a plant as this which was described by Greene as *M. sanguinea*. The author has been unable to find any differences which might not be ascribed to the differing conditions of its habitat. *M. acuta* Greene is a depauperate, unbranched form bearing a single terminal glomerule, which is in all respects that of *M. lanceolata*.

Typical *M. lanceolata* var. *microcephala* occurs only in the extreme southern portion of the specific range. The author has seen only one or two collections, even from the type locality, which equal the type collection in the extreme reduction in the size of the glomerules. All gradations occur, and it is a matter of opinion as to where the line may be drawn between the variety and the more typical plant. The writer has not seen the Orcutt collection which formed the basis for *M. peninsularis*, but from a comparison of the Orcutt material from the same locality with Greene's description, he feels certain that such a plant was represented, and that *M. peninsularis* is synonymous with the variety *microcephala*. In describing var. *microcephala* Abrams differentiated between it and the typical plant, among other things, by the absence of hispid hairs at the sinuses of the calyx. Johnston in describing var. *glandulifera* notes a point of difference between his plant and var. *microcephala* in that the hispid hairs are present. Careful examination shows that these hispid hairs about the base of the calyx teeth may be variously developed in different collections of the typical plant and the variety, and that while some sinuses may be naked, the calyx is rarely wholly so. This is true of the type collection of *M. lanceolata* var. *microcephala* and of the Orcutt collections. Furthermore, the stalked glands upon which the var. *glandulifera* was based may be found occasionally in both the typical plant and the variety *microcephala*, more especially in the southern forms, although no plants were observed in which they were as abundant as in the Johnston collection. It accordingly seemed preferable to consider Mr. Johnston's plant as a form of var. *microcephala*. A great diversity may be observed in the size of the glomerules upon a single plant, either of the variety or the more typical specimens, especially in the southern part of the range, such that it would appear that while environmental conditions had been favorable for the normal development of some of the glomerules others had been stunted or even aborted. At the same time vigorous plants with well-developed foliage usually have the glomerules of about the same size.

The foliage varies considerably, and robust, rankly growing plants may have quite a different aspect from those subjected to drier less favorable conditions. This variation in the leaf form is paralleled by an unusual development of the outermost bracts, or the involucral pair of leaves, which in some plants reach a length of several centimeters and thus form a reflexed foliaceous involucre. All gradations may be observed. Such a plant (N. C. Wilson, Mont Cr., Ariz., UC, 25461) has been named in the herbarium by some one "*M. lanceolata Arizonica.*" It is not peculiar to Arizona, however, but extends throughout most of the specific range, occurring in Butte Co., the Yosemite, the San Bernardino Mountains, and San Diego Co. It is considered to be only an environmental form.

One plant of Heller's collection, No. 12499 (OAC, 8932), while similar in all other respects to *M. lanceolata*, bore reduced corollas, with very small stamens. Since apparently normal (but smaller) seeds were produced, it will be of interest to note whether this variant has established itself. No other similar plant was found among the numerous collections of *M. lanceolata*.

Var. **microcephala** Gray, Syn. Fl. N. Am., ed. 2, **2**[1]: 459. 1886; Abrams, Muhlenbergia **8**: 42. 1912; Davidson & Moxley, Fl. South. Calif. 314. 1923.

Monardella peninsularis Greene, Pittonia **5**: 87. 1902.

M. lanceolata var. *glandulifera* Johnston, Bull. South. Calif. Acad. Sci. **18**: 20. 1919.

Madronella peninsularis Greene, Leaflets Bot. Obs. **1**: 169. 1906.

A form with the glomerules reduced in size to 1 cm. or less broad, the bracts and flower parts being reduced accordingly. The stems and branches are more slender and divaricately branched. All gradations seem to occur.

M. peninsularis Greene is based upon a collection made by Orcutt, June 6, 1885, in northern Lower California.

Specimens examined:

California: Potrero, July 24, 1883, *Orcutt 928* (GH, type; MBG); El Campo, dry valley, Aug. 14, 1917, *Munz 1681* (BH); Cameron's Ranch, Laguna, June 22, 1894, *Schoenefeld 3692* (US); Pine Valley, Aug. 12, 1894, *Mearns 3983* (US); near San Diego, 1875, *E. Palmer 257* (US); San Diego Co., April, 1890, *Orcutt* (MBG); Pine Valley, San Diego Co., *Orcutt* (MBG); mountains of San Diego Co., Aug. 1879, *Orcutt 57* (GH); Brown's Flats, San Antonio Mts., 4300 ft., Sept. 1, 1918, *Johnston 2139* (UC; BH, 4040; *type collection* of var. *glandulifera* Johnston, type in BH); ?Fish Creek, San Bernardino Mts., 6500 ft., July 10, 1906, *Grinnell 261* (US).

Lower California: Hansen's, July 30, 1883, *Orcutt 929* (GH); La Gralla, San Pedro Martir, 7000 ft., July 20, 1905, *Goldman 1255* (US).

15. M. Breweri Gray, Proc. Am. Acad. **7**: 386. 1867, and **11**: 102. 1876; Bot. Calif. **1**: 594. 1876; Syn. Fl. N. Am., ed. 2, **2**[1]: 357. 1886; Jepson, Fl. West. Middle Calif., ed. 2, 363. 1911.

Monardella Elmeri Abrams, Muhlenbergia 8: 43. 1912; Fl. Los Angeles, ed. 2, 318. 1917; Davidson & Moxley, Fl. South. Calif. 314. 1923.

Madronella Breweri Greene, Leaflets Bot. Obs. 1: 168. 1906.

Annual, erect, 15–65 cm. tall, branching throughout, the branches ascending, the lowermost longest, sometimes nearly equal to the main stem, rebranching, cinereous-puberulent above; leaves ovate-lanceolate or oblong, 1.5–3.5 cm. long, tapering at both ends, obtuse to slightly acuminate, puberulent, petioles 2–10 mm. long; glomerules 2–3 cm. in diameter, bracts *broadly ovate,* little exceeding the calyces, *abruptly acuminate to a cusp-like point, the veins 5–9, arising from the base, subparallel and converging at the tip, the midvein stronger and branching below,* the outermost bracts pinnately veined throughout, all *thinly pubescent or scabrous* on the veins; calyx 6–8 mm. long, 14–15-nerved, scarious below, the teeth acute, slender, unequal, hirsute within; corolla 12–14 mm. in length, rose-color, the tube retrorsely puberulent, the limb about 5 mm. long, the lips subequal, the lobes of the upper lip coalesced about two-thirds of the length of the lip or more, those of the lower lip coalesced almost one-third its length, tapering somewhat, obtuse, the anther-sacs subparallel, confluent behind above the connective, but little broader than the filament; nutlets oblong-oval, 1.5–1.8 mm. long, grayish brown and mottled.

Specimens examined:

CALIFORNIA: Monterey Co., Nacimiento River, Sept. 19, 1894, *Eastwood* (GH); Santa Lucia Mts. (received at GH, July 22, 1898) *Eastwood* (GH, fragment); Lemmon's ranch, Cholame, June, 1887, *Lemmon 4548* (GH); Acton, June, 1902, *Elmer 3681* (GH; MBG; FM; *type collection* of *M. Elmeri* Abrams, TYPE in DH); Corral Hollow, Contra Costa Co., east side of north Coast Range, east of Mt. Diablo, June 3, 1862, *Brewer 1213* (GH, TYPE; UC; US); edge of Antelope Valley near Neenach, June 6, 1896, *Dudley & Lamb 4341* (DH); Hernandez, San Benito Co., June 13, 1903, *Lathrop* (DH); 3 mi. above Acton on Palmdale-Saugus Road, June 12, 1918, *Ferris 949* (DH); Sprague's, Liebre Mts., Los Angeles Co., June 8, 1896, *Dudley & Lamb 4341* (BH); Lockwood Creek canyon, Mt. Pinos region, Ventura Co., June 24, 1896, *Dudley & Lamb 4668* (BH); San Antonio River, July, 1880, *Vasey 493* (US); San Miguelito Ranch, Santa Lucia Mts., June 14–20, 1901, *Jepson 1647* (J); near Templeton, July 20, 1913, *Abrams 5048* (DH).

While a well-marked species of fairly wide distribution, it has been little understood and often confused with *M. lanceolata*. Beyond the purplish, somewhat more scarious bracts of the Elmer and similar collections, I can see no essential difference between *M. Breweri* and *M. Elmeri*, certainly none sufficient to warrant specific distinction. The species may be readily distinguished from *M. lanceolata* by the more scarious acuminate bracts.

There are numerous "Corrals" and numerous "Hollows" throughout the state. "Corral Hollow," however, is near Tesla in Alameda County at an elevation of 1000–2000 ft. on the interior side of the coast range.

16. **M. Pringlei** Gray, Proc. Am. Acad. **19:** 96. 1883; Syn. Fl. N. Am., ed. 2, **2**^{1}**:** 459. 1886 (suppl.); Abrams, Muhlenbergia **8:** 42. 1912; Fl. Los Angeles, ed. 2, 318. 1917; Davidson & Moxley, Fl. South. Calif. 314. 1923.

Madronella Pringlei Greene, Leaflets Bot. Obs. **1:** 169. 1906.

Annual, erect, 15–40 cm. tall, cinereous-puberulent throughout, occasionally shortly villous near the inflorescence, branching throughout, the branches ascending, the lowermost longest, sometimes nearly equal to the main stem, rebranching; leaves ovate-lanceolate or oblong, 1.5–3.5 cm. long, tapering at both ends, obtuse or slightly acuminate, pubescent, petioles 2–10 mm. long; glomerules 2–2.5 cm. broad, bracts *ovate*, little exceeding the calyces or equal to them, *abruptly acuminate, veins 5–7, arising from the base, subparallel and converging at the point, the midvein stronger and branching below, the outmost bracts pinnately veined, villous with fine trichomes;* calyx 6–7 mm. long, 14–15-nerved, scarious below, pubescent, villous above, the teeth nearly equal, slender, acute, hirsute within; corolla 11–13 mm. long, rose-color, the tube puberulent, the limb 3.5–4 mm. long, the lobes of the upper lip coalesced two-thirds its length or more, those of the lower coalesced about a third its length, tapering, stamens exceeding the lips slightly, the anther-sacs divergent at an angle of about 90°, distinct, the connective about three times the width of the filament, the margin entire; nutlets oblong-oval, 1.2–1.5 mm. long, grayish brown and more or less mottled.

Specimens examined:

California: Colton, May, 1887, *S. B. Parish 1881* (MBG); locality not stated, 1881, *Parry* (GH); Colton, May 23, 1882, *Pringle* (MBG; US; GH; type); Colton, June 20, 1905, *S. B. Parish 5398* (GH); vicinity of San Bernardino, May 14, 1895, *S. B. Parish 3653* (GH; MBG; US); sandhills near Colton, June 20, 1907, *S. B. Parish 6396* (DH); Declez Pass, Jarupa Hills, June 20, 1904, *Wilder 199* (BH).

The relationship between *M. Breweri* and *M. Pringlei* is very close, and while some forms of one approach forms of the other, yet one may definitely and readily place them in one category or the other. The corolla of *M. Pringlei* is constantly smaller and of a different texture. The anthers, while similar, nevertheless show small points of difference, namely, a greater development of the connective, which is in general broader than *M. Breweri*, appearing more translucent, with the margin distinctly convex; in the rear, above the connective, the anther-sacs appear nearly or quite distinct. In addition to these rather obscure points, the nature of the bract, its smaller size, different texture, and woolly covering afford a ready means of distinction. While of similar aspect the entire plant is more slender and of less robust habit than *M. Breweri*. In some collections there is a suggestion of a scarious margin at the tip of the calyx teeth, the midrib being prolonged slightly.

17. M. candicans Benth. Pl. Hartweg. 330. 1839; Gray, Trans. Am. Acad. **11**: 102. 1876; Bot. Calif. **1**: 594. 1876; Syn. Fl. N. Am., ed. 2, **2**^{1}: 358. 1886; Jepson, Fl. West. Middle Calif., ed. 2, 363. 1911.

Madronella candicans Greene, Leaflets Bot. Obs. **1**: 168. 1906.

Annual, erect, 30–40 cm. tall, *branching from the upper nodes, forming a corymbose group of inflorescences;* branches seldom rebranching, purplish, puberulent; leaves lanceolate to oblong-lanceolate, 2–4 cm. long, obtuse, entire, puberulent or nearly glabrous, narrowed to a slender petiole 0.3–1 cm. long; glomerules

1.5–2.5 cm. broad, subglobose, bracts broadly *ovate, obtuse, scarious, the veins subparallel and green, the secondary veins net-like, evident, pubescent or puberulent, the margin villous-ciliate;* calyx 5–5.6 mm. long, scarious in the lower half, *13-nerved,* sub-glabrous below, villous above, teeth subequal, obtuse, the margin narrowly scarious and terminating in an *acute white scarious tip, but not cuspidate,* villous inside and out; corolla white, purple-dotted in some, 10–11 mm. long, the tube but little exserted, retrorsely puberulent, the limb 4–5 cm. long, the upper lip shorter, the lobes coalesced for more than half the length of the lip, those of the lower lip coalesced only at the base, the lobes of both rather broad, tapering, anthers oblong in outline, divergent at an angle of about 90°, quite distinct, the connective about three times the width of the filament, the margin notched; nutlets about 1.5 mm. long, mottled.

Specimens examined:

California: Auburn, Plumas Co., 1894, *Ames* (GH); no locality given, 1845–47, *Fremont's Exp.* (GH); Consumnes River, 1866, *Rattan 222* (US; GH); Yosemite, June 15, 1891, *Fritchey 80* (MBG); Fresno Creek, Madera Co., June, 1915, *Hall 10043* (GH; US; MBG; a very good match for the type); North Fork, May 30–June 8, 1903, *Griffiths 4619* (US; MBG); Volcano, Amador Co., June 25, 1896, *Hansen 1759* (MBG; US); Tollhouse, Fresno Co., June 13, 1900, *Hall & Chandler 26* (MBG; US); Colfax, July 4, 1882, *Jones 3458* (MBG; US); "Mt. Sacramento" (mountains of Sacramento River), no date, *Hartweg* (GH; labeled in Dr. Gray's handwriting "Pl. Hartweg. no. 1911," *type collection* from Herb. Benth.); Knight's Ferry, Stanislaus Co., May 7, 1854, *Bigelow,* Whipple's Exp. (GH); Calaveras Co., May 18–30, 1895, *Davy 1334* (UC); Greenhorn Range, Kern Co., June 2–10, 1904, *Hall & Babcock 5005* (US; UC); Eldorado Co., Sweetwater Cr., June 2, 1908, *K. Brandegee* (UC); no locality, *Bridges 308* (US); Coloma, Eldorado Co., June 23–24, 1892, *E. Palmer 2373* (US); Mariposa Co., June 15, 1892, *Congdon* (US).

18. M. exilis (Gray) Greene, Pittonia **5:** 86. 1902; Abrams, Muhlenbergia **8:** 43. 1912; Davidson & Moxley, Fl. South. Calif. 314. 1923.

Monardella candicans var. *exilis* Gray, Syn. Fl. N. Am., ed. 2, 2[1]: 358. 1886; Bot. Calif. 2: 476. 1880.

Madronella exilis Greene, Leaflets Bot. Obs. 1: 169. 1906.

Annual, erect, 10–30 cm. tall, cinereous-puberulent, brownish-purple, branching throughout, the branches flexuous, the lowermost longest, nearly equalling the main stem in some, rebranching; leaves oblanceolate to oblong, 1.5–2.5 cm. long, obtuse, narrowed to a slender short petiole or sessile, puberulent; glomerules 1.5–2.5 cm. broad, bracts *ovate*, usually surpassing the calyces, *scarious, but with green subparallel veins, with few or no secondary veins, the margin white-scarious, terminating in a short scarious abrupt acumination, the margin and back short-pubescent, the entire bract a bright purple in some;* calyx 5–5.5 mm. long, *15-nerved*, scarious in the lower half, sparingly pubescent, the teeth subequal with a *white-scarious margin and tip bristly without, hirsute within;* corolla white, 10 mm. long at most, the tube barely exserted, retrorsely pubescent, the limb 2.5–3 mm. long, the upper lip shorter, the lobes coalesced for more than half its length, those of the lower lip one-third to one-half its length, lanceolate, obtuse; stamens shortly exserted, the anther-sacs divergent at an angle of about 60°, the connective about twice the width of the filament, its margin entire.

Specimens examined:

California: Lancaster, May, 1909, *K. Brandegee* (UC); Palmdale, June, 1902, *Elmer 3648* (US; GH; MBG); Mojave River, June, 1886, *S. B. Parish 898c* (MBG; US); Walker Pass, Apr.–Sept. 1897, *Purpus 5347* (MBG; US); north fork Kern River, June 7–15, 1888, *E. Palmer 126* (GH; US; it was upon the sheets of this collection at the National Herbarium that *M. exilis* Greene was based); Mojave Desert, about 4000 ft., June 14, 1895, *S. B. Parish 3734* (GH; US); Mojave River, 1876, *E. Palmer 364* (US; GH; *type collection* of *M. candicans* var. *exilis* Gray, type at GH, a fragment at DH); Mojave Station, June 10, 1906, *Hall & Chandler 7382* (US; RMH; BH; UC); Rabbit Springs, 3000 ft., Apr. 29, 1906, *Hall & Chandler 6772* (UC); Mojave River, near Hesperia, May 31, 1892, *S. B. Parish 2450* (UC); Mojave River, Burcham's ranch, May 29, 1901, *S. B. Parish 4909* (DH); vacant lot, Lancaster, Los Angeles Co., *Ferris*

925 (DH); Lancaster, June 4, 1896, *Dudley & Lamb 4302* (BH); Victorville, spring of 1917, *Edwards* (BH); Little Rock Creek, sand flat, 3400 ft., *Peirson 2416* (BH; J); mouth of Deep Creek, Mojave Desert, May 19, 1921, *Jaeger 1155* (BH); Mojave Desert, May 17, 1882, *Pringle* (US).

While *M. exilis* resembles *M. candicans* in many ways, the author is of the opinion that the relationships between *M. candicans*, *M. leucocephala* and *M. exilis*, together with their relation to the other annual species is better shown by its retention as a species, rather than a subspecies or variety of *M. candicans.* It may be distinguished from the latter by the habit of branching, the smaller corolla and less exserted tube, the number of calyx veins, and more especially by the nature of the bract, which, despite the similarity, holds certain differences. These differences, when learned, permit it to be readily recognized, so that one may quickly separate a number of specimens, as they appear dried, by observation of the bract alone, due perhaps to the more opaque nature of the tissue, the greater crowding of the veins, the fewer and less conspicuous secondary veins, and the white-scarious margin and acuminate tip.

19. M. leucocephala Gray, Proc. Am. Acad. **7:** 385. 1867; ibid. **11:** 102. 1876; Bot. Calif. **1:** 595. 1876; Syn. Fl. N. Am., ed. 2, **2**[1]**:** 358. 1886; Jepson, Fl. West. Middle Calif., ed. 2, 363. 1911.

Madronella leucocephala Greene, Leaflets Bot. Obs. **1:** 169. 1906.

Annual, erect, 15–20 cm. tall, cinereous-puberulent, branching throughout, the branches regularly dichotomous, ascending, the lowermost longest; leaves lanceolate or oblong-lanceolate, obovate in one specimen, 1–1.5 cm. long, pubescent, the veins scarcely evident, on petioles 2–3 mm. long; glomerules 1.5 cm. in diameter, subcorymbose, bracts *ovate, orbicular or obovate,* with a short acumination, *scarious, pure white,* the veins parallel from the base but not prominent, the cross veins few; calyx 5–6 mm. long, tapering downwards, *15-nerved,* hirsute above, the teeth *white, attenuate into a spreading and recurved white cusp;* corolla white, 5–5.5 mm. long, *nearly included within the calyx,* the upper lip shorter, incised less than half its length, the lower lip incised about two-thirds its length, the lobes lanceolate, acute, the middle lobe of the lower lip somewhat larger than the lateral lobes; stamens included, *those of the upper lip appearing sessile,* the anthers subsagittate, the anther-sacs subparallel, the connective wider than the filament, indented; nutlets oblong-oval, tapering toward the base, 2 mm. long, apparently only one maturing.

Specimens examined:

CALIFORNIA: plains near Merced "near the river," June, 1866, *Bolander 4845* (GH, TYPE; US; UC, four sheets); Merced, June, 1878, *Bush* (GH); Merced Plains, July 15, 1896, *Jepson 100h* (J).

M. leucocephala is a very distinct and interesting plant; it is to be regretted that it is not better known. The matured calyces fall away, leaving a roughened cruciate receptacle which persists.

INDEX TO SPECIES

Synonyms are printed in *italics*; species or genera maintained in this paper are printed in Roman type; new species, subspecies, or combinations are indicated in **bold face** type.

Explanation of Plate

PLATE I

Map of western United States, showing distribution of *M. odoratissima.*

P —*M. odoratissima* subsp. *pallida*
E —*M. odoratissima* subsp. *euodoratissima*
D —*M. odoratissima* subsp. *discolor*
Po —*M. odoratissima* subsp. *pinetorum*
Pv —*M. odoratissima* subsp. *parvifolia*
A —*M. odoratissima* subsp. *australis*
G —*M. odoratissima* subsp. *glauca*

EPLING—MONOGRAPH OF MONARDELLA

Explanation of Plate

PLATE 2

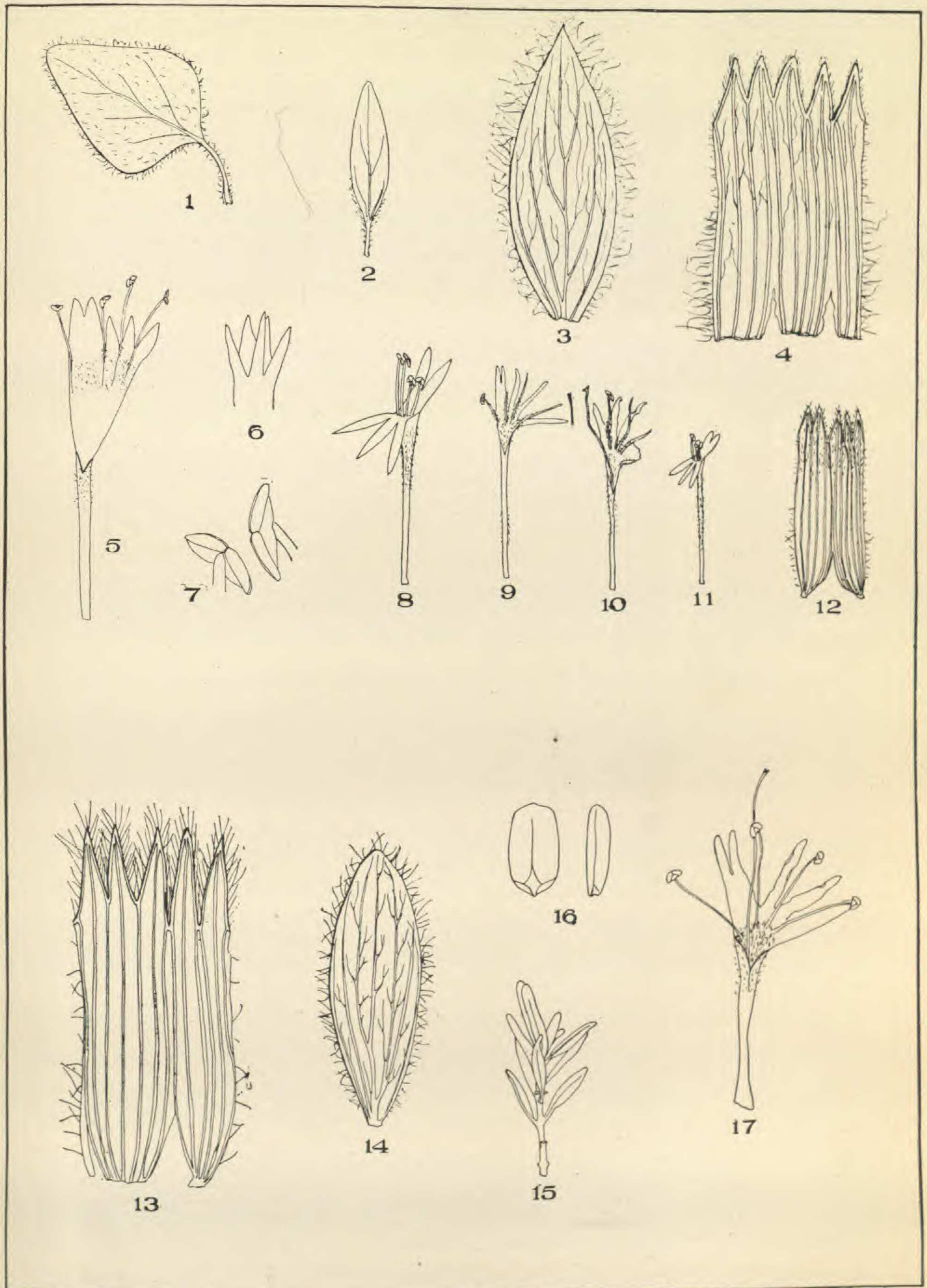
Monardella macrantha

Fig. 1. Leaf of var. *Hallii*, × 2.
Fig. 2. Leaf of subsp. *eumacrantha*, × 2.
Fig. 3. Bract, × 5.
Fig. 4. Calyx of subsp. *eumacrantha*, × 4.
Fig. 5. Corolla of subsp. *eumacrantha*, × 2.
Fig. 6. Limb of var. *Hallii*, × 2.
Fig. 7. Anthers, × 20.
Fig. 8. Corolla of var. *tenuiflora*, × 2.
Fig. 9. Corolla of subsp. *nana*, × 2.
Fig. 10. Corolla of subsp. *nana*, × 2 (from type).
Fig. 11. Corolla of var. *arida*, × 2.
Fig. 12. Calyx of subsp. *nana*, × 2.

Monardella Palmeri

Fig. 13. Calyx, × 10.
Fig. 14. Bract, × 5.
Fig. 15. Foliage, × 5.
Fig. 16. Nutlets, × 20.
Fig. 17. Corolla, × 5.

All drawings of *M. Palmeri* are from the type.



EPLING—MONOGRAPH OF MONARDELLA

Explanation of Plate

PLATE 3

Monardella villosa

Fig. 1. Corolla of subsp. *euvillosa*, × 5.
Fig. 2. Bract, × 5 (villosity not shown).
Fig. 3. Corolla of var. franciscana, × 5.
Fig. 4. Anthers, × 25.
Fig. 5. Calyx, × 10.
Fig. 6. Outer bract, × 5 (villosity not shown),
Fig. 7–16. Leaves of various types, pubescence not shown.

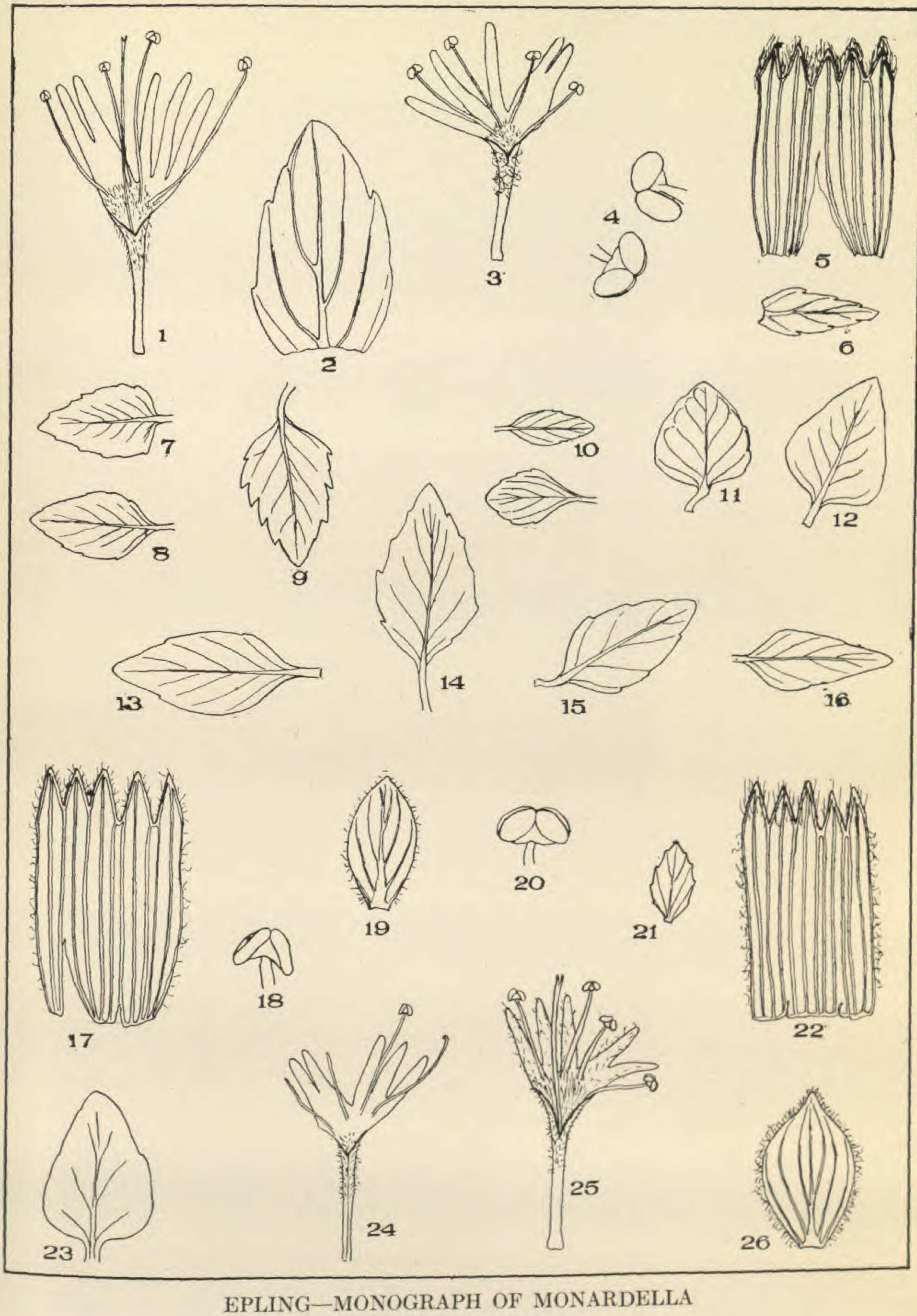
M. thymifolia

Fig. 17. Calyx, × 10.
Fig. 18. Anthers, × 20.
Fig. 19. Bract, × 5.
Fig. 23. Leaf, × 5 (villosity not shown).
Fig. 24. Corolla, × 5.

M. cinerea

Fig. 20. Anther, × 20.
Fig. 21. Leaf, × 2.
Fig. 22. Calyx, × 10.
Fig. 25. Corolla, × 5.
Fig. 26. Bract, × 5.

Drawings made from type.



EPLING—MONOGRAPH OF MONARDELLA

Explanation of Plate

PLATE 4

Monardella hypoleuca

Fig. 1. Calyx, × 10.
Fig. 2. Anther, × 25.
Fig. 3. Corolla, × 5.
Fig. 4. Bract, × 4.
Fig. 5. Leaf, upper surface, × 2.
Fig. 6. Leaf, lower surface, × 2.

Drawings made from type.

M. lanata

Fig. 7. Corolla, × 5.
Fig. 8. Leaf, × 2.
Fig. 9. Anthers, × 25.
Fig. 10. Calyx, × 10.
Fig. 11. Leaf, lower surface, × 2.
Fig. 12. Leaf, lower surface, × 2 (villosity not shown).
Fig. 13. Leaf, upper surface, × 2 (villosity not shown).
Fig. 14. Bract, × 5.

Drawings made from type collection.

M. saxicola

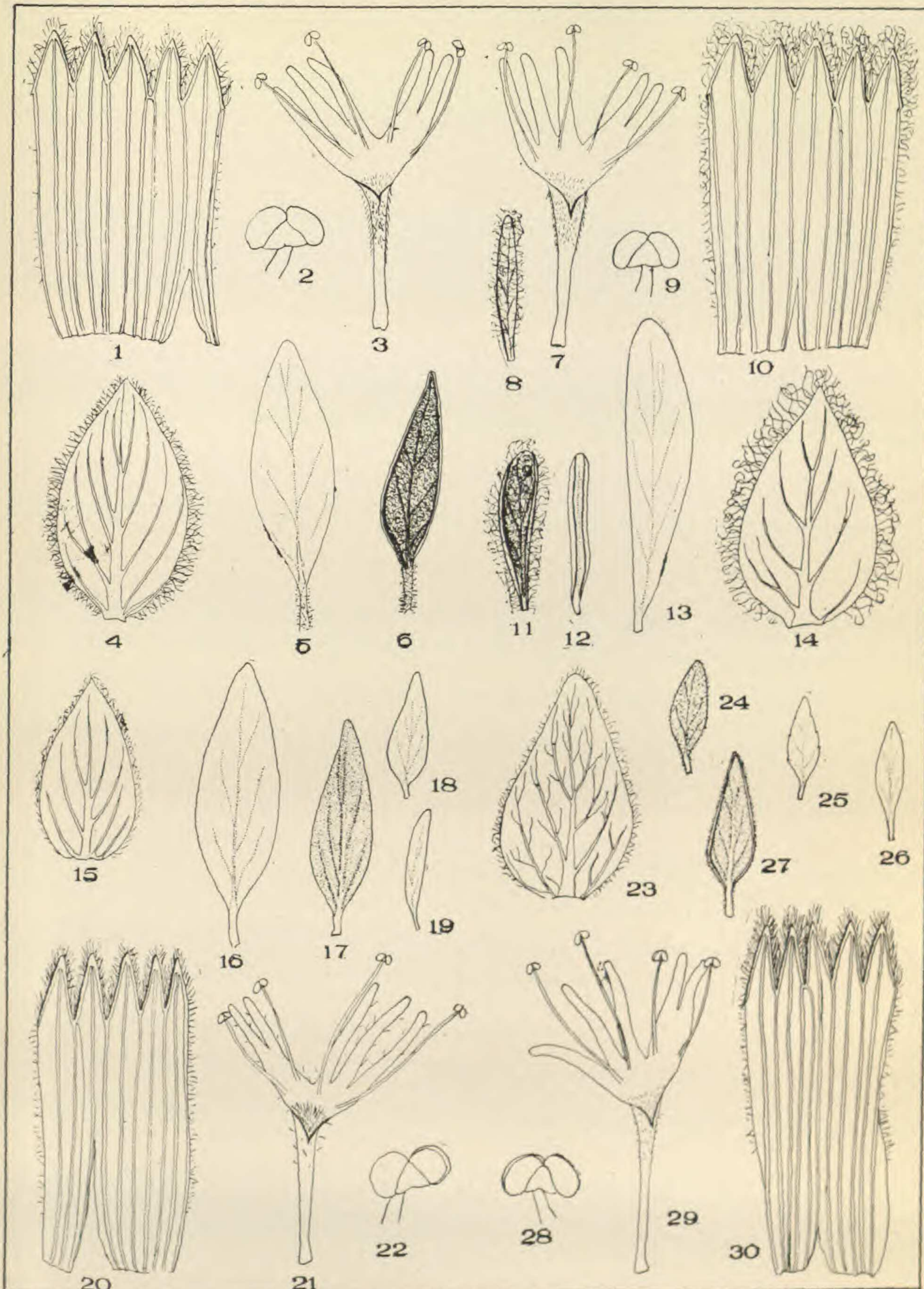
Fig. 15. Bract, × 5.
Fig. 16. Leaf, upper surface, × 2.
Fig. 17. Leaf, lower surface, × 2.
Figs. 18–19. Leaves, upper surface, × 2.
Fig. 20. Calyx, × 10.
Fig. 21. Corolla, × 5.
Fig. 22. Anther, × 25.

Drawings made from type.

M. viridis

Fig. 23. Bract, × 5.
Figs. 24–26. Leaf, upper surface, villosity not shown in last two, × 2.
Fig. 27. Leaf, lower surface, × 2.
Fig. 28. Anthers, × 25.
Fig. 29. Corolla, × 5.
Fig. 30. Calyx, × 10.

Drawings made from type collection.



EPLING—MONOGRAPH OF MONARDELLA

Explanation of Plate

PLATE 5

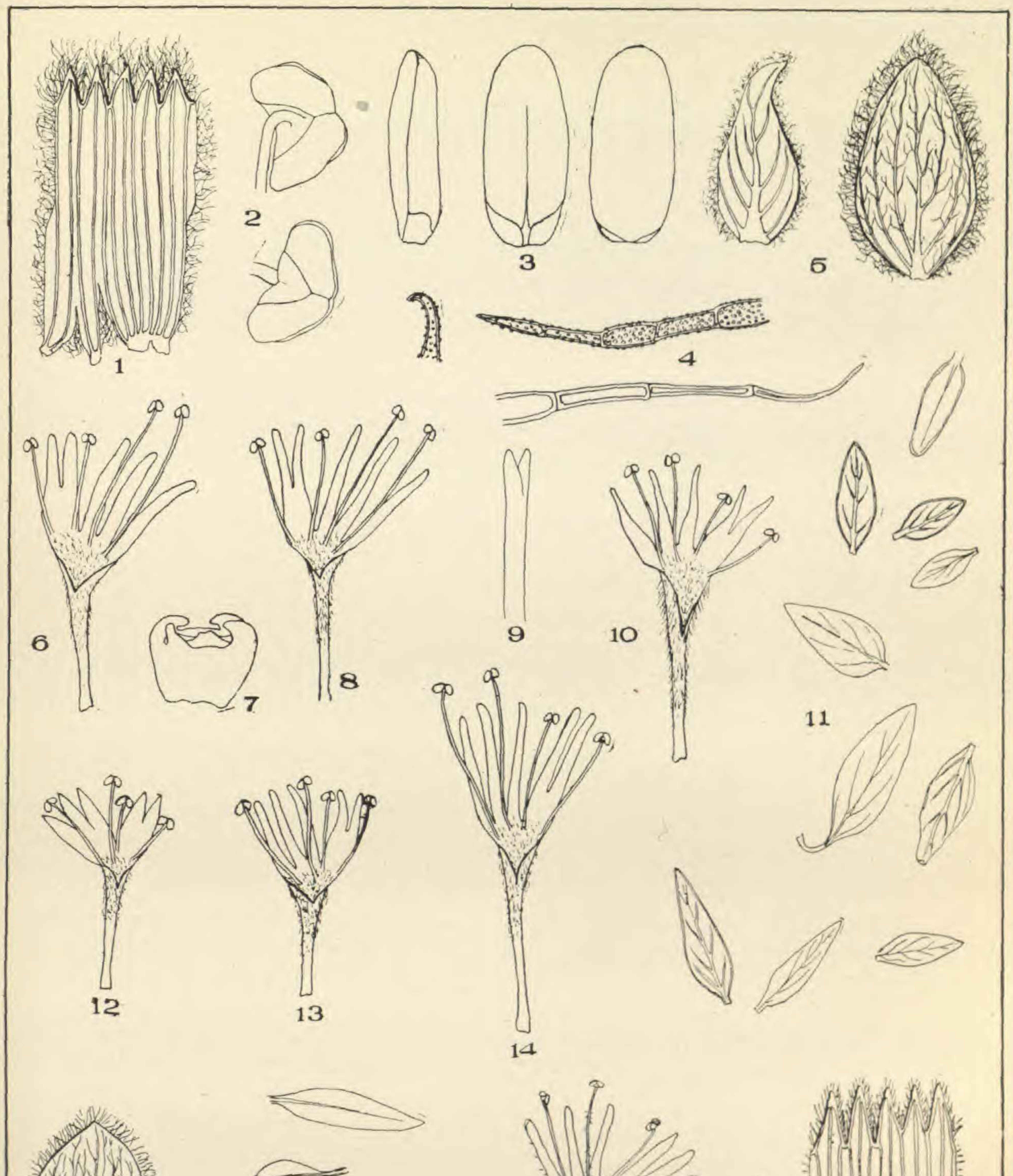
M. odoratissima

Fig. 1. Calyx, × 5 (subsp. discolor).
Fig. 2. Anthers, × 50.
Fig. 3. Nutlets, × 50.
Fig. 4. Trichomes common to the genus.
Fig. 5. Bracts, × 5.
Fig. 6. Corolla of subsp. *discolor*, × 5.
Fig. 7. Gynobase after nutlets have fallen, × 50.
Fig. 8. Corolla of subsp. *euodoratissima*, × 5.
Fig. 9. Tip of style, × 50.
Fig. 10. Corolla of subsp. *glauca*, × 5.
Fig. 11. Types of foliage, × 2 (pubescence not shown).
Fig. 12. Corolla of subsp. *pallida*, × 5.
Fig. 13. Corolla of subsp. *parvifolia*, × 5.
Fig. 14. Corolla of subsp. *australis*, × 5.

The corollas represented above are those which are common in the subspecies indicated. All gradations may be found.

M. linoides

Fig. 15. Bract, ×5.
Fig. 16. Types of foliage, × 2 (pubescence not shown).
Fig. 17. Corolla, × 5.
Fig. 18. Anthers, × 20.
Fig. 19. Calyx, × 10.



EPLING—MONOGRAPH OF MONARDELLA

Explanation of Plate

PLATE 6

M. undulata

Fig. 1. Calyx, × 10.
Fig. 2. Foliage, × 2 (pubescence not shown).
Fig. 3. Anther, × 25.
Fig. 4. Bracts, × 5 (the second outermost).
Fig. 5. Corolla, × 5.
Fig. 6. Leaf, × 2.

M. Douglasii

Fig. 7. Bracts, × 5 (the second innermost).
Fig. 8. Calyx, × 10.
Fig. 9. Anthers, × 25.
Fig. 10. Corolla, × 5.
Fig. 11. Foliage, × 2.

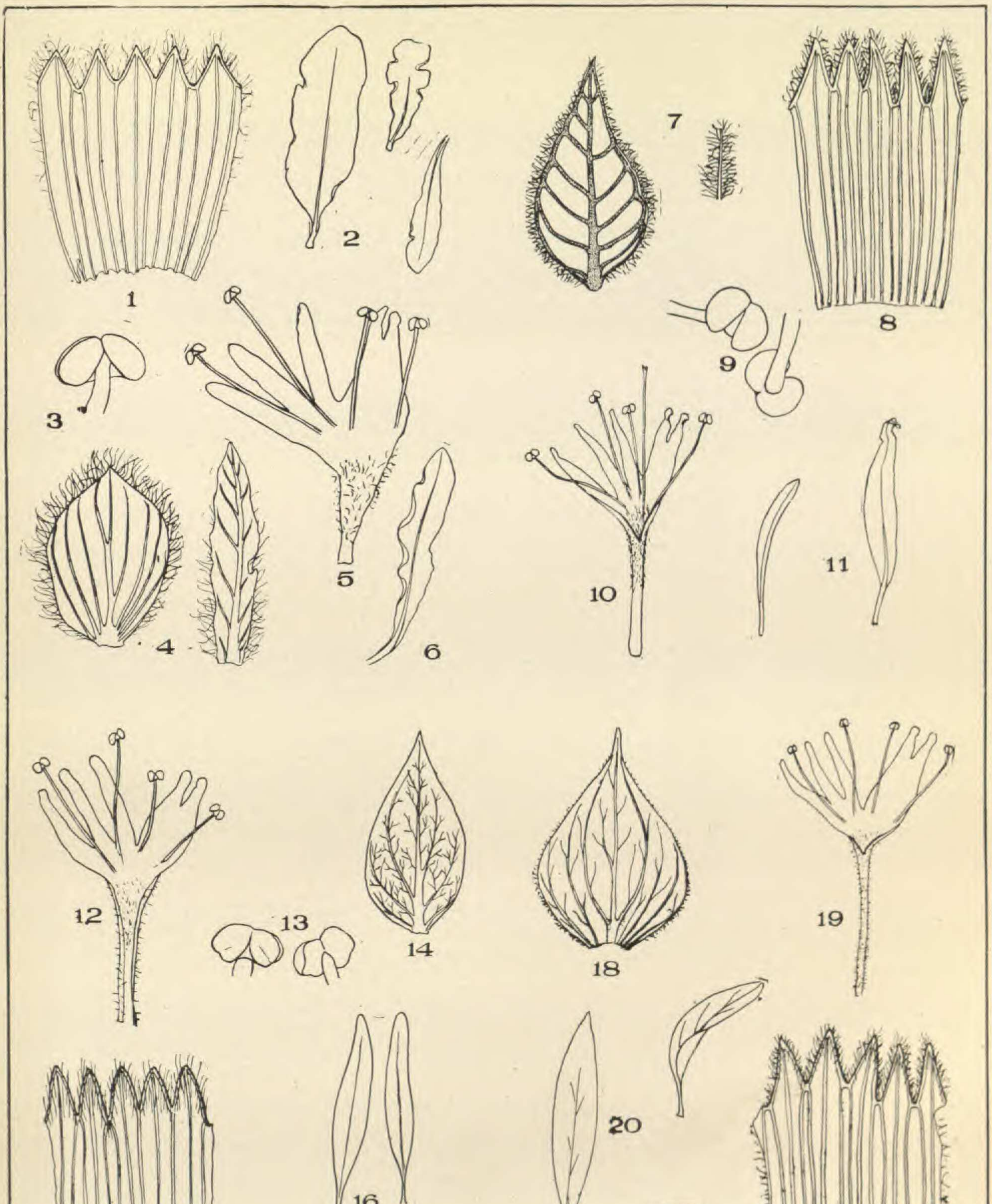
M. lanceolata.

Fig. 12. Corolla, × 5.
Fig. 13. Anthers, × 25.
Fig. 14. Bract, × 5.
Fig. 15. Calyx, × 10.
Fig. 16. Foliage, × 2.
Fig. 17. Nutlets, × 10.

M. Breweri

Fig. 18. Bract, × 5.
Fig. 19. Corolla, × 5.
Fig. 20. Foliage, × 2
Fig. 21. Anthers, × 25.
Fig. 22. Calyx, × 10.

Drawings made from type.



EPLING—MONOGRAPH OF MONARDELLA

Explanation of Plate

PLATE 7

M. candicans

Fig. 1. Calyx, × 10
Fig. 2. Corolla, × 5
Fig. 3. Nutlets, × 10.
Fig. 4. Foliage, × 2.
Fig. 5. Anthers, × 25.
Fig. 6. Bract, × 5.

M. exilis

Fig. 7. Corolla, × 5.
Fig. 8. Calyx, × 10.
Fig. 9. Anthers, × 25.
Fig. 10. Leaf, × 2.
Fig. 11. Nutlets, × 10 (? mature).
Fig. 12. Bract, × 5.
Drawings made from type.

M. Pringlei

Fig. 13. Bract, × 5.
Fig. 14. Corolla, × 5.
Fig. 15. Anthers, × 20.
Fig. 16. Calyx, × 10.
Fig. 17. Leaf, × 2.
Drawings made from type collection.

M. leucocephala.

Fig. 11. Corolla, × 10.
Fig. 12. Bract, × 5.
Fig. 20. Leaf, × 2.
Fig. 21. Nutlet, × 10.
Fig. 22. Anthers, × 35.
Fig. 23. Calyx, × 10.
Drawings made from type.